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INTERNATIONAL UNIVERSITY COLLABORATION

IN the two years since the British Association's Committee on Post-War University Education issued its report on world-wide university collaboration, much has been done to facilitate such co-operation ; and the importance of the contribution of the universities in building the post-war world has become steadily more widely recognized. The universities are vitally concerned with the restoration of full freedom of communication by publication of the results of research, the exchange of ideas by publication and the exchange of visits of men of science and other scholars, upon which so much emphasis has been placed in recent months. Indeed, they must share some responsibility for the action necessary to secure and enlarge the freedom which is one of their most precious traditions—a tradition which has been gravely imperilled in some countries. With the imposition of a particular ideology, the ancient freedom of the universities has completely disappeared, and its restoration is a necessary condition of any true university fellowship and co-operation in the international field.

The re-establishment of full freedom of communication in the intellectual field is one of the first and most urgent of the tasks which the War has left for the universities—and it is a task the execution of which will be shared with professional organisations and learned bodies of many kinds. Along with it goes the re-establishment of some common traditions and standards of learning, of cultural, spiritual and moral values, without which it will be idle to expect the United Nations or any other international organisation to be effective. That, of course, is one reason for the establishment of the United Nations Educational, Scientific and Cultural Organisation, the need for which was discussed tentatively in the British Association Committee's report. The belief expressed in the preamble to the constitution of that Organisation—"in full and equal opportunities for education for all, in the unrestrictive pursuit of objective truth, and in the free exchange of ideas and knowledge"—is inherent in the very idea of a university. The universities, in fact, cannot stand apart from an Organisation pledged "to develop and to increase the means of communication between their peoples and to employ these means for the purposes of mutual understanding and a truer and more perfect knowledge of each other's lives".

The very formation of the United Nations Educational, Scientific and Cultural Organisation is thus a further challenge to the universities of Britain to shed that insularity which received such pointed comment two years ago at a Conference of the Association of University Professors and Lecturers of the Allied Countries in Great Britain. It may well be a further reason in support of the world council of universities linked up with the proposed advisory council of universities of Great Britain, into which the British Association Committee in its report suggested the Association of Professors and Lecturers of

Allied Countries might develop. The Association of University Teachers, in the second half of Part 3 of its Report on University Developments*, most of which is concerned with the international functions of a university, endorses the same idea in hoping for the establishment of an international university institute.

This part of the report of the Association of University Teachers adds very little, however, to this discussion, or to that of the British Association Committee's report, on such subjects as the exchange of staff and students and the mutual recognition of qualifications; although in the meantime, such activities have been specifically indicated as among the purposes of the United Nations Educational, Scientific and Cultural Organisation. The tasks now confronting the universities in the international field are nevertheless rightly summed up as participation in the rehabilitation of the universities and of the academic life of the devastated countries of Europe and of Asia; and in the building up of permanent fruitful intercourse with colleagues in other countries.

In its widest sense, as the Association of University Teachers remarks, the international function of a university is that of affording opportunities to learn something of the whole world and its problems, which are likely to affect more and more the destiny of each individual country. If the universities are in future to carry the further responsibility of including schools of education and the training of teachers in their purview, it will be even more essential to implement the views expressed in this report that no student should leave the university without having had ample opportunity to broaden his horizon in this widest sense, and that more teaching should be provided in such subjects as twentieth-century European and Commonwealth history, human geography and contemporary political thought. Similarly, however, it is important to discharge the university's international responsibility in the narrower sense of establishing more and closer relations with the universities of other lands, for example, by promoting the meeting and interchange of teachers and of students.

The practical problems of re-equipping universities, libraries and similar institutions damaged by the War are already receiving the attention of the new Educational, Scientific and Cultural Organisation, and no doubt this immense task will call for the services of experts in the universities in an advisory capacity. Equally important, however, is the provision of facilities for study and research for university teachers abroad who are without such facilities in their own countries, as well as for many students who cannot pursue their studies satisfactorily or completely at home. These are matters in which the universities can act individually and collectively, and they should also consider the claims for support of the International Association of University Professors and Lecturers, formed in September 1944, with the object of developing "academic fraternity among university teachers" on the basis of the "freedom of teaching and research". Such support is needed to counter nationalist and racialist distortions of research and to liberate science and learning from the control of governments and political groups.

The particular contribution of the Association of University Teachers here will be the encouragement of, and co-operation with, free associations of university teachers in all lands. Relations must again be entered into with such associations, through correspondence and periodical conferences at which the issues facing the universities of all lands can be debated and agreement made for joint action. Besides this, there is great need for extending the international system of visiting lecturers; in this respect the Association considers that the most generally useful arrangement is that which provides for a course of about half a dozen lectures. To obtain the full benefits of interchange, however, longer periods are necessary, and the report suggests the establishment of visiting professorships, supernumerary to the existing establishment, to which teachers of standing from abroad should be invited for a period normally not less than one academic year. The Association believes that the establishment of such professorships in all countries, and the acceptance of interchange as a normal feature of university life, would be to the general advantage.

Such exchange schemes should also be open to members of university staffs who have not reached professorial status, and visiting fellowships are suggested. Much good might accrue if pairs of universities in different countries initiated alliances of mutual advantage in respect of opportunities for interchanges and other matters, as has already been done by the Imperial College of Science and Technology in London and the Massachusetts Institute of Technology. A valuable adjunct of any scheme of interchanges of staff would be the provision of special rooms in university hostels or halls of residence, in which visitors could be officially entertained, if their stay were prolonged more than a few days. The facilities for international migration in the form of travelling scholarships and fellowships which existed before the War should be revived as soon as conditions permit; and the report also recommends that the importance of increasing such facilities should be impressed upon government agencies such as the British Council and upon the great educational trusts.

In regard to students, the report emphasizes the desirability of overseas students living in the university halls of residence, in order to promote that contact with British university students which could be a vital cultural force in student life. Where foreign students are received in any considerable number, a special tutor or tutors should be appointed by each university to look after their welfare. The report praises the work of the National Union of Students in regard to the exchange of shorter visits

* Association of University Teachers. Report on University Developments. Part 3: Comprising the Education of Teachers: The International Functions of a University. Pp. 8. (Bristol: J. W. Arrowsmith, Ltd., 1945.) 1s.

of students through holidays, holiday courses and conferences; and in regard to finance, points out that the ideal of interchange will fail of one of its primary objects if students are compelled by financial stress to spend all their time within the confines of university life. They must be able to move about, see the country, and make contact with various groups of the population.

Finally, the report considers very briefly the question of the mutual recognition of entrance requirements, courses and degrees. This is a matter in which the professions may also be concerned, and for those of medicine, law and teaching may involve inter-governmental agreement, as well as the collaboration of the universities in exploring the problems, which is clearly the first step. The report also looks for the establishment of an international university institute which would perform for the universities of the world as a whole those functions for which the Universities Bureau of the British Empire was founded in connexion with the imperial universities.

Some of the functions of that Bureau may well come under the consideration of the Commonwealth Scientific Conference to be held in June, for in regard to the collection and provision of up-to-date information on all phases of university life and organisation there is considerable room for improvement of the facilities as yet available within the British Empire. Whether the present Universities Bureau could be adequately staffed and financed for this purpose, or whether the work would be better done in regard to the world as a whole by the proposed institute, may be a matter for discussion; but the Association visualizes functions for the proposed institute which go far beyond anything yet attempted by the Universities Bureau in respect of the Empire alone. Other suggestions are for a library of documentation to aid in the comparative study of university systems; the collection of materials for research into methods of instruction, into new educational movements within the sphere of the universities and into the problem of student welfare; the provision of a centre of organisation for international university conferences, and an instrument for establishing contacts between universities and for carrying through negotiations, especially in regard to the machinery for interchange of staff and students—these are all so far beyond the present resources of the Bureau, that it may not be worth while to expand it to deal with them if such functions can conveniently be fulfilled for the world as a whole by an international institute. But some clear thinking is called for on the part of university authorities of Great Britain in these matters before the Commonwealth Scientific Conference meets, so that they may be ready with constructive proposals to meet the demand they will then most assuredly have to face, for the provision of more adequate information regarding their collective facilities and resources, and for more efficient means of communication and interchange between themselves and other universities of the Empire, apart altogether from their international responsibilities in the widest sense.

SCIENCE, FAITH AND EDUCATION

The Authoritarian Attempt to Capture Education

Papers from the 2nd Conference on the Scientific Spirit and Democratic Faith. Pp. x+152. (New York: King's Crown Press; London: Oxford University Press, 1945.) 16s. 6d. net.

THIS record of a sustained symposium, held in New York in 1945, provides a book of quite unusual value. With rare exceptions, the contributors play their parts under a strong sense of responsibility, aware both of the urgency of the great matters they are discussing and of the issues that hang upon the finding of a solution. One could wish that they were all equally well agreed concerning the depth of the level at which a solution must be sought. But the actual discussion is marked by the sincerity, the seriousness, and the candour which so great a theme rightly evokes.

The central interest of the book is education, particularly higher education. Although at times the discussion seems to take the form of a head-on clash between science and tradition, it has certainly not that character as a whole. The more responsive participants are fully alive to the truth that education is not conceivable apart from the continuous re-creating of a cultural tradition. They are concerned not with a battle against tradition, but with the need, now so urgent, of developing and reinterpreting it so as to incorporate the attitudes and the temper of life and thought which are characteristic of science. They seek, that is, a synthesis, not an outright victory.

Some part of the discussion consists of an attack upon that out-of-date traditionalist solution which is associated with the name of President Hutchins of the University of Chicago, who would make a study of the 'hundred best books' the substance of general higher education. President Hutchins' critics find it easy enough, occasionally in devastating fashion, to demolish his proposed solution. In the opinion of this non-scientist reviewer, they are much less successful in shaking the presuppositions upon which his not well-considered proposals rest.

The title given to the symposium calls for remark. Does not the loosely used word 'Authoritarian' beg the question? One can see what it is intended to convey. But the use of the word in this condemnatory sense does excite the query whether, just as education is not conceivable apart from tradition, it is not also inconceivable apart from authority? If so, a doctrine of authority is a necessary part of a philosophy of education. Should the critic answer that the scientific intelligence is itself the authority, that still leaves some vital educational issues unanswered, especially those that arise in the education of young children and in the field of moral standards and actions. It is possible that preoccupation with the higher levels and the more purely intellectual fields may account for some neglect of an issue which, for the student of education as such, must always loom large.

The general impression left by the book is, however, that beyond all doubt men of science are on the side of the angels, that they are even more acutely aware than the rest of us of the vast crisis to which all our Western culture has been brought by the development of science, and even more earnest and resolute in searching for the moral and intellectual synthesis which will provide a firm foundation for reconstruction. That much can be said and should be said with all possible emphasis. To regard men of

science, as some still do, as the reckless villains of the modern tragedy, is not only cruelly unjust, it is also to preclude all possibility of finding the synthesis that, presumably, we are all alike seeking.

After reading this book, the non-scientist may feel that it would help greatly if his scientific colleagues would turn for a while to re-examine the presuppositions upon which their modes of thought and inquiry proceed. It is plain nonsense, and disastrous nonsense, to talk as though by some arbitrary decision scientific inquiry could be confined to a specific region of knowledge, demarcated for it by non-scientific considerations. Not by such blind and stupid means is any solution of our troubles to be found. The methods of science must continue to be applied wherever they can produce valid results. It is rather in this region of the critique of presuppositions that the debate can proceed much more fruitfully. One may hope that scientific men will participate in it not only as scientists but also as just men and citizens, as indeed so many are now doing. They will certainly serve the cause of wise and sound education most valuably if they can continue thus to stand apart, as it were, for a time, from their specific activity and view it critically from the point of view of a total human experience.

In this symposium, for example, it is easy to distinguish those contributors who take this wider point of view from those who speak from the narrower one of the man who is all scientist and no more. In particular, is it over-daring to suggest that we should all be helped if we gave a little fresh thought to the use we make of the word 'dogma'? When a certain kind of scientific worker uses it, we guess that he means only dogmas of a certain kind, not his own unexamined ones. Thus the writer of the preface to this volume can write of its contributors: "They are not dogmatic in their insistence on any one truth or any set of truths. They believe that all truths, whatever their origin, are established by the scientific method." "They believe"! What is there undogmatic in that forthright sentence? Or again, a contributor concludes: "It becomes necessary to meet the challenge to free minds by those who believe that science, democracy and education—all three—must get their direction from supernatural religious beliefs". But is the supernatural (whatever that may mean) the only source of dogma? Does the issue concern merely some vague empyrean, set above science, as it were, and not also a whole region of intellectual presuppositions underlying science?

So, when one of the contributors declares roundly that "the scientist cannot have 'faith' of any kind", one is left wondering how he manages to exist as man enough to be a scientist.

These instances must not give the impression, however, that the participants are in general unconcerned with the deeper human issues. Indeed, for all of them, in some form or other, that is the main concern. It is rather the mode of approach of many of them that excites questioning. Thus the supreme issue of values, so central for education, comes up again and again. In one penetrating contribution by a philosopher this passage occurs: "Until we look upon all values as human and fallible valuations, until we regard them with the same distrust and critical scrutiny relative to their claims and evidence or justification for their claims that a physicist employs as a matter of course towards his facts, hypotheses and laws, education will continue to be haphazard and irresponsible".

One can recognize freely the element of truth and timeliness in this declaration, while marvelling a little at the possibility of a firm assertion of the relativity of all values in the name of one absolute value—that of truth.

So the debate, so worthily carried on by this symposium, must continue. Some study of the present record induces one to hazard the suggestion that it will proceed more fruitfully and with greater benefit to the study of problems of education if certain understandings could be accepted on either side.

On the side of the non-scientists, could we not hope that there will be an end to any idea of imposing arbitrary limits upon the scope within which scientific methods may be applied, and together with this, at least some re-thinking of the common distinction between science and the 'humanities' as though they were opposed rather than complementary? Of the men of science, it might be asked that they would look again into the precise nature of the presuppositions upon which they work, and inquire whether it is possible to emancipate themselves from 'dogma' as completely as some appear to suppose. It might be a further advantage if they would face again quite squarely, in all its bearings, the central question of all: whether the methods of science really are capable of providing every form of knowledge that man needs for the purposes of his human existence. So much depends upon the answer to that, and not for education alone.

F. CLARKE.

MATHEMATICS OF GAMES AND ECONOMICS

Theory of Games and Economic Behavior

By John Von Neumann and Oskar Morgenstern. Pp. xviii + 625. (Princetown, N.J.: Princetown University Press; London: Sir Humphrey Milford, Oxford University Press, 1944.) 66*s*. 6*d*.

THIS book is based on the theory that the economic man attempts to maximize his share of the world's goods and services in the same way that a participant in a game involving many players attempts to maximize his winnings. The authors point out that the maximization of individual wealth is not an ordinary problem in variational calculus, because the individual does not control, and may even be ignorant of, some of the variables. The general theory of social games, in their view, offers a simplified conceptual model of economic behaviour, and a study of that theory can do much to throw light on certain basic concepts of economics, for example, that of utility.

The first chapter of the book introduces this basic idea, and seeks to establish the dualism between standards of economic behaviour and strategies in social games. It is stated that various authors have tried to build up a mathematical theory of economic behaviour, with a conspicuous lack of success, due to a combination of unfavourable circumstances. The most important of these is that the economic problems are not formulated clearly, and are often stated in such vague terms as to make any attempt at a mathematical solution hopeless. Also the empirical background is definitely inadequate. Another difficulty is that the problems which have been attempted have frequently been dealt with by methods so complicated that the so-called proofs are really only assertions, which are of less value than the same assertions in literary form. The great progress in

every science came when, in the study of problems which were modest as compared with ultimate aims, methods were developed which could be extended further and further. The sound procedure is to obtain first utmost precision and mastery in a limited field, and then to proceed to another somewhat wider one, and so on, until finally the field of real success is reached, that is, prediction by theory. The authors state that there is no reason why economics can expect any easier fate than that which befell other sciences such as physics and chemistry, and that it will not be possible to build up a complete mathematical theory for many years to come.

Having formulated the basic economic problems, the book now turns to the mathematics of games themselves. The mathematics are self-contained, in the sense that theory is developed from primitive ideas, but an extensive use is made of set-theory, and of course mathematical notation. Forty pages are spent in formulating the general description of a game, introducing all possible complications into the theory, and finally describing the game in terms of ten axioms. It is then shown that these can be reduced to three, the two definitions being rigorously equivalent. The two definitions are designated as 'Extensive' and 'Normalised' respectively, and it is sometimes found convenient to use one, and sometimes the other in the problems which follow.

The next chapter starts with a discussion of one-person zero-sum games, for example, patience, then advances to zero-sum two-person games, the discussion being dominated by illustrations from chess, poker, bridge, etc., and not from cartels, markets, oligopolies. The theory now passes on to three-person zero-sum games. It is shown that whereas a one-person zero-sum game is merely a simple maximum problem, the passage from a one-person zero-sum game to a two-person zero-sum game obliterates the maximum problem, and the game is designated by a clear-cut opposition of interest. Similarly the passage to the three-person zero-sum game obliterates the opposition of interest. Here independent coalitions may arise, and the relationships between two players may be manifold. The game can be reduced to three two-person zero-sum games.

The theory now advances to the n-person zero-sum games. Little penetration below the surface has been made, however, and the theory comes back to a discussion of the case $n = 4$. Even here, however, the problem is soluble only in certain special cases. Some aspects of $n \geqslant 5$ are now considered, but the problem becomes so complicated that it seems rather hopeless to push this approach beyond $n = 5$. On the other hand, it is absolutely vital to get some insight into the conditions which prevail for the greater values of n. Quite apart from the fact that these are most important for the hoped-for economic and sociological applications, there is also this to consider: with every increase of n, qualitatively new phenomena appeared. This was clear for each of $n = 2, 3, 4$. It was not observed for $n = 5$, but this may have been due to lack of detailed information about the case. It will appear later that very important qualitative phenomena make their first appearance for $n = 6$.

For these reasons, it is imperative that some technique should be evolved for the attack on games with higher n. In the present state of affairs nothing systematic or exhaustive can be hoped for. Consequently, the natural procedure is to find some special classes of games involving many participants which can be decisively dealt with. Two families of such special cases are then formulated and discussed, each considered as generalizations of four-person games.

The trend of the book now alters. The zero-sum restriction is dropped, and the theory comes into close contact with questions of the familiar economic type. After a short discussion of the general case which consists mainly of plausible arguments, an economic interpretation is given for $n = 1$ and 2, and for a special case of $n = 3$.

From the point of view of notation alone, it is doubtful whether anyone but a fairly competent mathematician would be able to follow the arguments put forward. This was unavoidable, but seems a pity as the book will remain closed to economists who are unfamiliar with mathematical ideas and methods.

E. ROWLAND.

EVOLUTIONARY THEORIES OF ETHICS

The Moral Theory of Evolutionary Naturalism

By Prof. William F. Quillian, Jr. (Yale Studies in Religious Education, No. 17.) Pp. xiii+154. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1945.) 20*s*. net.

THIS is a careful, fair but completely devastating analysis of the evolutionary theories of ethics which were very fashionable towards the end of the nineteenth century and still have a considerable vogue. It deals mainly with the work of Darwin, Spencer, W. K. Clifford, Leslie Stephen, Guyau and Westermarck. Later writers do not appear to have produced any fresh arguments.

As Dr. Quillian insists, the evolutionary naturalists were undoubtedly right in asserting that man is a part of Nature, that his morals have evolved and that a process comparable to natural selection is at work. Their error was in saying there is nothing else and in smuggling the notion of obligation surreptitiously into what purported to be a factual account. Guyau and Westermarck, it is true, realized that earlier writers were confused about obligation, and professed to dispense with the notion. But had they really done so, they would have had no theory left. They only appeared to do it by a further confusion. Assertions of conditional obligation may be made to look entirely factual so long as the unconditional obligation on which they rest is not discussed. 'Over-eating causes illness' is an assertion of fact, from which the conditional obligation, 'I ought not to over-eat', can be derived, if 'I ought to keep well' is itself unconditional or else derived from some other unconditional obligation.

The evolutionary naturalist is liable to assume tacitly that mere survival is the one unconditional obligation, though whether of the individual or the race he is not clear; nor is he clear why we should pursue an aim that inevitably ends in frustration. He has no criterion to distinguish the life which is worth living, however short, from that which is not, however long.

The only criticism to be made of this book is that there is too much quotation for easy reading, and that the writing is uninspired. Can the evolutionist or anyone else explain why books on ethics are duller than other philosophical books?

A. D. RITCHIE.

Sechsstellige Trigonometrische Tafel

Edited by Herman Brandenburg. Pp. xxiv+304. (Copyright vested in the Alien Property Custodian, 1944: first published in Leipzig, 1932.) (Ann Arbor, Mich.: J. W. Edwards; London: Dr. J. L. Comrie, Scientific Computing Service, Ltd., 1945.) 5 dollars.

THE main content of this volume consists of a six-figure table of sines, tangents, cotangents and cosines over the range 0°–45°. Each page represents a range of 10 minutes, the intervals being 10 seconds, so that it contains 60 entries for each of the four functions. Each individual entry is supplied with its corresponding first difference, and tables of proportional parts are also appended.

In order to assist in computing, the parts of the table where exact interpolation is impossible (owing to insufficient data) have been substantially enlarged and appear in the form of two preliminary tables. The former, occupying 24 pages, gives values of the cotangent over the range 0°–3°, at intervals of one second, to seven significant figures; while the latter, occupying three pages, gives values of the sine and tangent, over the range 0°–1°, at intervals of 10 seconds, to six significant figures.

Other information supplied at the end of the book includes conversion tables from mean time to sidereal time and vice versa and also from arc to time. There is, in addition, a table of factorials and their reciprocals from 1 to 20.

The original preface to the book, written by the author in 1931, has been translated into English, French, Dutch, Russian, Spanish and Japanese, and all seven prefaces are included. The book is another fine example of lithoprint reproduction and is published and distributed under the authority of the Alien Property Custodian in the United States. It is excellently reproduced and neatly bound, and should prove a useful asset to all who are fortunate enough to be able to acquire it. J. H. PEARCE.

Good Farm Workmanship

By D. V. Fletcher. (Teach Yourself Farming Series.) Pp. 180. (Bickley: English Universities Press, Ltd., 1944.) 3*s*. net.

THE written description of highly skilled manual work is naturally very difficult, especially if it has to be understood by readers not acquainted with the work. The author of this book deals in turn with each of the main departments of a mixed farm and gives a lucid account of the series of skilled operations performed by each farm worker, and the reasons underlying them. The book is presented in an interesting and very readable form, and the author obviously knows his subject well.

The picture painted by the author is, however, rather too full of colour, for all farm work is made to appear pleasant and well organized, with no dull tedious work, no back-breaking slogging at harvest time and no groping about in milking sheds with lanterns on cold dark mornings. It is, in fact, a picture of farm-work as it should be done, rather than how it is done on most farms. This is not necessarily a fault in a book of this nature, for the novice would soon learn of the difficulties by experience, and would soon realize that the easy skill of a farm-worker can only be acquired after much practice. The seasonal routine work of the general farm-worker renowned for his skill in many operations does not get the space it deserves, for this work plays by far the largest part on most farms. Much more might have been made of this part of the book.

The book will be of interest to laymen and of use to people on the threshold of an agricultural career, but it will not satisfy these latter for long, as they will soon want to pass on to something more advanced. J. R. MOFFATT.

Virus as Organism

Evolutionary and Ecological Aspects of some Human Virus Diseases. By Dr. Frank MacFarlane Burnet. (Harvard University Monographs in Medicine and Public Health, No. 8.) Pp. ix+134. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1945.) 2 dollars.

DR. BURNET'S monograph is a welcome contribution to the literature on the viruses. A subject so wide and so rapidly changing requires periodic summarization so that new concepts may be made known to the wide medical public which cannot cope with the spate of articles directed at the specialists. The origin, evolution and economy of the viruses are here outlined from a biological point of view. The author postulates the evolution of the viruses from larger micro-organisms by a process of parasitic degeneration, and the derivation of human virus diseases from animal infections. Examples are given to show the differences which can exist between variants in virus strains.

Evolution is scarcely the word to describe the progress of virus life, for in this process there is no increase in complexity or emergence of new powers. On the contrary, the onward trend is towards more and more simplification in structure until in the smallest viruses nothing remains but a "shadowy, self-replicating residuum of genetic mechanism". There is an enormous reservoir of viruses in arthropod, bird and mammal life, and chance may allow the appearance in the future of new virus diseases in man. Illustrations of the behaviour of viruses and their hosts are given in chapters on individual diseases: herpes simplex, poliomyelitis, psittacosis, smallpox, yellow fever and influenza.

There is a comprehensive bibliography. This excellent book can be recommended as a concise summary of the recent advances and present conceptions in virus diseases.

L'Azéotropie

La tension de vapeur des mélanges de liquides, bibliographie. Par Maurice Lecat. Tome 2, pour 1932–1941, avec compléments rétrospectifs. Pp. x+128. (Bruxelles: Maurice Lamertin, 1942.) 125 francs.

THE first volume of the present work appeared ten years ago, and the present second volume deals with the literature, including many patent specifications, which has appeared since. It also includes many entries which are not contained in the first volume, although belonging to the earlier period. The entries appear twice, under authors, and chronologically. The book is printed on one side only, so that additional entries can be made. The subject has a high scientific and technical interest, and such a collection, which must have cost a great deal of labour on the part of the author, is valuable and important. The paper and printing are good, and although the book is not bound, it has a stout cover which will stand much usage. It can be recommended for inclusion in any chemical library.

SCIENCE AND TECHNOLOGY IN CHINA'S FAR SOUTH-EAST

By Dr. JOSEPH NEEDHAM, F.R.S.
British Scientific Mission in China

THE two provinces covered in this article are those of Kuangtung and Fukien. Both differ widely in their dialects from all other parts of China and from each other, and during the War they had a different fate. In the campaign of 1944, the Japanese driving south along the Hankow-Canton railway linked up with the Japanese coming up from Canton, capturing Kuangtung's temporary provincial capital, Kukong, and destroying the scientific institutions in its neighbourhood. Fukien, on the other hand, ringed round as it is on the landward side by mountains and forests, has suffered only intermittent Japanese occupation of its main ports, Fuchow and Hsiamên (Amoy). It remains a sort of Valley of Avalon, isolated, with its two excellent universities, from the ravages of war in the plains of Chiangsi and Kuangtung to the west.

Kukong, as it appeared to a visitor in 1944, was a particularly pleasant city, built on sandy soil at the junction of the Peichiang and one of its main tributaries, with flowery gardens, and streets arcaded in southern style against the sun. To the north, some four hours by train, up a noble defile in the mountains followed by river and railway, at Pingshek, was the Chungshan (Sun Yat-Sen) University, with outlying colleges, especially that of agriculture, at Liyuanbao; and the Lingnan University College of Agriculture at Pingshek itself. Nearer towards Kukong, at a small town called Lochang, was the Chungshan Medical College. Nearer still, at a halt in moorland country called Hsienrjêngmiao ("Fairy Temple") were the two Universities of Lingnan and Tungwu. Finally, in Kukong itself was the Lingnan Medical College.

The largest of these organisations, Chungshan University (acting president, Chin Tsêng-Têng), had had a particularly melancholy history of evacuation. Before the original fall of Canton, it had made its way to far-off Yunnan, but after becoming established there, was recalled by the Kuangtung Provincial Government. It was estimated that one third of the equipment was lost on the outward journey, and another third on the way back. Though still including some eminent scholars, such as Dr. Chu Chien-Tze (historian of Asiatic-European culture contact), Dr. Yang Chêng-Chih (editor of the *Journal of Chinese Folklore*), Dr. Wu Kang (philosophy), Dr. Wang Ya-Nan (economic history), and Dr. Shêng Chêng (pupil of Bataillon at Montpellier and friend of Patrick Geddes) for whose autobiography Paul Valéry wrote a preface—Chungshan was but a shadow of its former self.

On the scientific side it is noteworthy that among all Chinese universities, Chungshan alone maintained an astronomical observatory. Under the remarkable woman director Dr. Chou Yi-Hsin, teaching work with about a dozen students was proceeding with a 6-in. equatorial telescope. A transit instrument used as zenith telescope for determination of latitude and time from star positions was set up and in use.

In the biological laboratories Dr. Chang Tso-Rjêng (a pupil of Guilliermond's), whose inspiring influence on the students was obvious, was working on the nuclear cytology of root-hairs under the influence of colchicine. Though good microscopes were available, many substitutions, such as that of gasoline locally produced by cracking camphor oil, for xylol, had to be made. Systematic ornithology was flourishing under Rjên Kuo-Rjung from the Paris Museum, and systematic botany under Yung Chi-Tung. Biological work on a much larger scale was in progress at the Agricultural College some 40 km. away at Liyuanbao. Of outstanding interest was the very active work of Dr. Chao Shan-Huan and his collaborators (who have been, through the British Scientific Mission, in touch with Dr. Tattersfield and others) on naturally occurring insecticides. The chicken-blood vine, *Millettia pachycarpa*, had proved as good as derris against a wide variety of insects, such as biting lice, plant bugs, aphids, leaf beetles, house flies, lice and bedbugs. Similar good results had been obtained with the thundergod vine, *Tripterygium exesum*, and with the yam bean, *Pachyrrhyzus eresus*. The whole of this work, which included also the mass production of arsenical and copper sprays, etc., from local minerals, was a model of energetic and resourceful action under most difficult conditions. Another strong line of this College was soil science, under the veteran dean, Dr. Têng Chih-Yi, who had organised an excellent provincial soil survey and a soils museum. Notable also was the work of Wên Wên-Kuang (plant growth-hormones), Fêng Tze-Ching (sex hormones in domestic animals), Dr. and Mrs. Pu Chih-Long (pathology of the silkworm), Dr. Chiang Ying (systematic botany and wood anatomy), and Lo Tong-Chien (forestry), who had started plantations of the lightest of known woods, *Paulownia fortunei*, for the Chinese Air Force. All in all, this agricultural college was perhaps the largest and best, both for research and teaching, which I have seen in my wanderings in China.

Chungshan University Medical College (dean, Li Yu-Sêng), at Lochang, with its teaching hospital in very modernistic style (though constructed only of local materials, wood, bamboo, brick and plaster), showed markedly the influence of the German training of most of its staff, in the order and cleanliness typical of old-fashioned German culture. Outstanding here was the pathologist Dr. Liang Po-Chiang, who had a good deal of research going on, for example, on schistosomiasis, on curious miliary abscesses of the spleen (common in North Kuangtung) probably caused by *Spirochæta recurrens*, on congenital intestinal diverticula, on fœtal chondrodystrophy, etc. This medical school was designed for 150 students but had actually 300. Dr. Yang Chien, in anatomy, completely lacking preservatives, was back in the sixteenth century with Vesalius, and had to get dissections finished in one or two days.

Lingnan University occupied one of the most beautiful temporary campuses in China, some distance from the railway, in a magnificent grove of camphor trees, with wooden buildings with porches and verandahs of pleasant design. The parasitologist Dr. Chen Hsing-Tao was head of the faculty of science here, there being very little physics or chemistry. The medical college was headed by Dr. Ling Shu-Mo, a former collaborator of the Eggletons at Edinburgh, who had worked with them on phosphagen and carnosine. Since returning to China he had had little opportunity for research.

To go to Fukien Province from Kukong, one must travel across the Province of Chiangsi, with its very good roads, passing through the large town of

Ganhsien, formerly the headquarters of the thriving south-eastern Chinese Industrial Co-operative Federation. At the time of my visit, many co-operatives were still working, and the machine-shop and boat-building yard were both visited. Eventually, after passing through tumbled and forested mountain country, one crosses the border and reaches the small town of Changting, the war-time headquarters of Amoy University. Parallel to it, in the north of the province, on the only other road leading to and from Fukien from the interior, lies Shaowu, the war-time location of Fuchow University. Though the former is of governmental and the latter of missionary origin, both are of high quality and compare very favourably with the four great universities of the far west (see *Nature*, **153**, 238; 1944 and references there to earlier articles). They are also in a happier position than most Chinese universities, in that their trek of only a few hundred kilometres was comparatively short, and the volume of books and equipment, brought directly up the rivers, is considerably larger than that of the universities which had to travel for perhaps two thousand kilometres or more.

At the time of my visit to Changting, President Sah Bên-Tong, a well-known electrical engineer, had just left for the United States, and my old friend from Roscoff and Paris days, Wang Teh-Yao (pupil of Wintrebert's), was acting for him. The University Library has a beautiful building, the guildhouse or hostel and temple combined of the Chiangsi merchants who formerly came to Changting to trade with the merchants of Fukien. In the scientific faculties there is a good deal of activity. Thus Dr. Chen Tze-Ying (a pupil of T. H. Morgan's), who did formerly a classical piece of work on imaginal buds, now keeps the best *Drosophila* stocks in China (using the sweet potato instead of the banana as food), though most of his war-time activity has been the making of agar from the seaweed *Geladium cartilagenium* of the Fukien coast (mostly quite clear of the enemy), and of anti-goitre preparations from other seaweeds, especially *Eklonia*. The promising young biologist Liao Hsiang-Hua works on isopod parasites, especially a queer one named *Icthyoxenus chengi*, which forms an enormous pouch within the belly of the loach *Crossostoma stigmata*. In physics, Dr. Chou Chang-Ning (a Cavendish man), though very isolated, is still doing theoretical work on cosmic rays. He had seen no new journals for four years, he had no electric current, no vacuum grease, in fact no means of using even the small amount of apparatus in stock. But by some method known only to himself, he was still keeping fairly cheerful. The geologist Chen Yün-Tun had exerted himself in making slide rules, logarithmic and other graph paper, for sale. This is an example of the initiative of Fukien people, just as photographic paper was being made at Yungan; but few of these products were getting out to the other provinces in the farther interior. The physical chemist Tsai Chi-Rjui had managed to do some very interesting work on the determination of mixtures of lower fatty acids up to valeric by the E.M.F. of hydrolysis of their cadmium salts, using a distribution coefficient method.

At Shaowu, in the north of the province, at Fuchow University, the picture was similar. Under President Ling Ching-Rjun, the library, augmented by Chinese books from many famous Fukien families, has become one of the best in all China. The biological laboratories are also unusually extensive, and Dr. Chêng Tso-Hsin, who heads the department, said that it had been a positive advantage to them to move into the country from Fuchow, as a different faunistic zone had been made available for study. There were very large collections of birds and reptiles, and a large marine collection. It was interesting to see specimens of the giant tree-toad *Rhacophorus schlegelii* which used to be worshipped by the Fukien peasants. A recent popular exhibition arranged by the students had been crowded out by the townspeople. The able entomologists Chao Hsiu-Fu (dragon-flies) and Ma Chün-Chao (of the provincial entomological survey), and the parasitologist Tang Chung-Chang, a specialist on blood flukes, were hard at work. Dr. Ting Han-Po was making parabiosis and hybridization experiments with the interesting local species *Pachytriton brevipes*.

This University maintains a special Tea Research Laboratory (Chang Tien-Fu). It is very near the famous Wu-I (Bohea) Hills, where fine tea is grown. We brought away a number of tins of the university-made tea, which has a high reputation. Other branches of agricultural science are also active, under a number of Cornell men, with large gardens and an experimental farm.

Though chemistry and physics are now practically confined to teaching here, the level which this formerly attained is attested in a remarkable way. Dr. Ling I, a Fuchow University graduate, who has never studied outside China, has been responsible for an industrial development of exceptional interest and great value for the Province. During the past few years, with the blockade entirely cutting off supplies of gasoline, the provincial buses and trucks have been running almost exclusively on a gasoline prepared from cracking the turpentine-like oil obtained by dry distillation of pinewood roots, which would otherwise be thrown away. The northern part of the province has a network of river communications which bring down the roots to several central distilleries. Unlike aliphatic vegetable oils such as tung oil, cracked so widely throughout China, the aromatic pinewood oil cracks with difficulty. The necessary aluminium catalyst is provided by balls of a local acid clay, like fuller's earth, which are suspended in wire cages above the oil in the cracking chambers. The octane number of the gasoline as finally used is quite high—about 75. The main plant has an excellent lubricants and analytical laboratory in the buildings of a finely carved old temple. When it is remembered that the greater part of the apparatus is constructed out of old steel gasoline drums, bamboo piping, and derelict boilers from the Fuchow navy yard, some idea of the initiative and perseverance of Dr. Ling I and his chief chemist Dr. Ni Sung-Mao can be gained. Fulfilling its purpose admirably within the province, this enterprise was one of the most inspiring examples of war-time improvisation I have seen in China, and holds considerable possibilities for the use of by-products of the lumber industry even for peace-time.

There are many other ways in which Fukien is an interesting province from the scientific point of view. It is the only province in China to have a provincial Academy of Sciences. This is located at the temporary capital, Yungan, and has initiated work in agriculture, industrial chemistry, biology and soil conservation. At the time we were there it was suffering greatly from lack of apparatus and funds, but important botanical collections were being made by Dr. Ling Rjung, who has discovered many new species in the unexplored hinterland of the province. The head of the Academy is Dr. Chou Chang-Yün, who also heads the very active provincial geological and soils survey.

Another notable figure at Yungan is Dr. Shih Yen-Han, head of the provincial meteorological survey, the best in China. The Yungan station is an elaborate one with an excellent library, and we were able to forward to Britain a complete set of the records and publications. Printing in Fukien is better than elsewhere in China, so that works such as Dr. Ma Ting-Ying's "Past Climate and Continental Drift" have been published by the Survey. The provincial agricultural college, too, was well-equipped and active under the leadership of Dr. Yen Chia-Hsien, and it was interesting to visit the power plant, producing 130 kW. from an 11m. fall, with entirely Chinese-made piping, turbines, and dynamos. Mention should also be made of Huanan Women's College at another city, Nanping, where neat science teaching facilities were found; if Ginling College at Chengtu is China's Girton, this is its Newnham.

Unfortunately, it has been necessary to use the past tense in this article also. Having established a line of communications with these various institutions, I returned to the west, a few steps ahead of the Japanese, only to find that with the loss of Kuangsi, all contact with the scientific workers in Fukien was cut off, while the institutions in Kuangtung were before long disbanded and destroyed. After the examinations in the summer of last year, the students at Chungshan, Lingnan, and Tungwu Universities, and their agricultural and medical colleges, disbanded; and later the teaching and research staff also dispersed into the zones away from the roads and railways, taking with them in bits and pieces what equipment they could. It is said that the Chungshan Medical School has re-formed itself at Meihsien, in eastern Kuangtung, a district not occupied by the Japanese; but if so it is quite isolated. We have been able to welcome a few scientific men here mentioned, such as Liang Po-Chiang, Ling Shu-Mo, and Chêng Tso-Hsin, who managed to find their way to West China, but the majority have remained behind, and nothing is known of their activities. Thus the two Kuang Provinces have suffered the worst damage to science and technology during 1944, while Fukien is completely isolated. This is extremely regrettable, because some of the best scientific institutes in China were in the far south-east.

NUTRITION IN JAPAN

By Dr. GEOFFREY H. BOURNE

JAPAN is a country of eighty million people and her pre-war empire (including Manchuria) embraced 105 million people. The problem of feeding such numbers has been considerable, and the difficulties which Japanese communications experienced as a result of Allied air and sea attack did not make this problem any simpler. It will perhaps be of interest at this stage, therefore, first to discuss Japanese diet and then to analyse the food situation in that country.

Generally speaking, the chief types of food now eaten in Japan include polished rice, with a certain amount of fish, beef, veal, pork and mutton and a few eggs, together with some Western vegetables and soya bean in various forms, particularly as soya bean curd. This last is made by soaking the beans in water, mashing them, straining the mass through cloth and solidifying it by the addition of magnesium chloride. Rice was first eaten in Japan in the unpolished condition; but as soon as the milling and polishing of rice was introduced the custom of eating the grain in this condition began to spread and rapidly extended to all classes of the population.

The diet of the Japanese cannot be described as good. Milk and butter, for example, play little part in it. Butter was probably introduced in Japan during the latter part of the eighteenth century and milk was introduced some time later by a Korean who brought it from Chosen. The first milk was used in medicine and was served only at great feasts, and butter was also served at feasts pounded up in rice cakes. Although both butter and milk were introduced early in Japan, neither entered into the lives of the common people.

In general, the Japanese diet can be described as predominantly carbohydrate in nature, which results, in effect, in an increased demand for vitamin B_1. At the same time, the vitamin B_1 content of the diet is reduced by polishing the rice, which is the predominant carbohydrate. Dr. E. C. Grey says (League of Nations publication, 1928) that the physical nature of rice is such that people are bound to use it in the polished condition. Rice must be consumed as a grain; it lacks gluten, the elastic constituent of wheat flour which enables it to be made into bread and macaroni. "The natural rice grain," says Dr. Grey, "is rough to the tongue and unpleasing to the palate, it is not so easily digested and has none of the pleasing appearance of the pure white grains of polished rice."

The Japanese diet is also deficient in fat. In 1928 the daily intake of this nutrient was only about 15–20 gm. a day, which is only about one quarter of the desirable intake. 85 per cent of the fat which was consumed was vegetable fat and therefore contained no fat-soluble vitamins. In 1925 the average daily calorie intake in Japan was approximately 2,732. This is the figure for food before it was prepared for the table. Allowing 10 per cent for wastage the figure comes to little more than 2,400 calories, which, considering that the main mass of the people are manual workers, was too low.

Protein was derived principally from fish and soya beans, and a very small quantity from beef and other meats in certain classes. Fish and other marine products are not entirely satisfactory as the sole sources of animal protein because of the variation in the seasons. When there is a good season, fish is so plentiful that it is used as manure; when a bad season arrives there is not enough fish to go round. Soya bean, which contains a high-quality protein, forms the most stable source of protein.

The feeding of Japanese children, particularly those of the working classes, has always been extremely poor. The lack of milk is one of the principal reasons for this. Even that which is available is produced under very unhygienic conditions, and the effects of drinking it are usually far from good. In fact, this unattractiveness of animal foods is possibly one of the reasons (apart from cost) why Japanese people eat very little of them; another reason is, of course, that few people know how to cook them. As a result of the deficiency of cow's milk, Japanese children tend to be breast-fed for a very long time. Attempts are made to use a substitute milk made from the soya bean. Infant feeding and hygiene does not appear to have improved very much in recent years, for the average mortality for the five-year period 1934–39 was still 115 per 1,000 live births, which is

four times the rate for New Zealand and twice the rate for England and Wales.

The imperfections in the Japanese diet have been known to the rulers of that country for some time, and they have realized, too, that bad diet makes bad soldiers. Twenty years ago, therefore, the Japanese Government requested the Imperial Institute of Nutrition in Tokyo to take up the questions, first, of improving the Japanese diet, and secondly, of making Japan so far as possible self-sufficient in foodstuffs. The Japanese attack in the Pacific was obviously already taking shape in the minds of the Japanese rulers. Dr. Saiki, who was director of the Imperial Institute of Nutrition, set out originally to formularize the Japanese diet, so that by about the present time the entire population of the country could be fed on what could be described as 'domestic foods' at the cost of a few pence per person per day.

But Japan was not big enough herself for this scheme to be entirely effective. She has only relatively recently become a military or an economic power of any significance. In the first decades of the sixteenth century she lived in a turmoil of civil and foreign wars. For more than two hundred years her people were not permitted to emigrate or to colonize, and as a result Japan did not become a colonial power until relatively late in world history. It was with intensive agriculture at home and in the colonies that she became practically self-sufficient in quantity of food by 1930. But that was not enough; her diet was still very bad in quality. Dr. Saiki's job was to advise how this could be improved and to work out the minimum effective diet for the population. To this latter end he estimated in his Institute the energy value of something like ten thousand different native Japanese foods, and he worked out some hundreds of different menus at the same time. The Imperial Institute commenced a great deal of propaganda on nutrition by publishing pamphlets, and, immediately before the War, there were regular broadcasts from the various radio stations on the subject of nutrition, and all the Japanese women's magazines printed articles on food. The custom of mass feeding was begun some years ago. Communal kitchens were established and it is probable that most of the factories in Japan were drawing the food for their workers from a communal kitchen of one sort or another. Dr. Saiki also produced a number of different dishes, some of his creations including cats stuffed with peeled locusts and grasshoppers baked in soya bean sauce. Despite these attempts to make Japan self-sufficient in food, she is not herself able to produce all the food she needs.

With her colonies, however, and including Manchuria, Japan was before this War able to make herself practically self-supporting in this respect; 99 per cent of all the rice consumed in Japan was grown by herself and her colonies, Chosen and Taiwan. Japan could not have been self-sufficient in soya beans without Manchuria, because 60 per cent of her soya beans are imported from that country. One of the reasons why Japan was able with the aid of her colonies to become almost self-sufficient in food was because, for the fifteen years or so preceding this War, she had carried out a highly intensive cultivation based on the use of relatively enormous amounts of chemical fertilizers. At the onset of war with China in 1936 much of the chemical industry in Japan had to be turned over to producing explosives instead of chemical fertilizers, and as a result Japan had in 1939 one of the worst crops that she has had for a very long time. It has actually been described as a disastrous crop failure. Despite this fact, however, her food situation was still very good, particularly as she was able to import as much rice as she needed from countries like Burma, Siam, French Indo-China and to a lesser extent occupied China itself. On the other hand, food brought from these countries must come in ships, and shipping was at a premium in Japan during the last months of the War.

As a result of this, the use of rice for the production of *saké*, which is a variety of wine, was very much reduced, there was widespread food rationing in the towns, and there was also a limit to the amount of food that could be bought at any one time. For example, all householders' purchases were restricted to not more than ten days' food. The amount of food allowed was worked out first according to the age, and, secondly, according to the occupation of the person, in a similar way to that in which the rations were graded in the German ration system. The rations were fairly generous, and as a result of the War there does not seem to be any particular shortage of food in Japan. There was, however, a considerable shortage of fish, and fish is almost the entire source of animal protein for nearly all of the Japanese population. The chief reason for this is that the supply of fish in the areas close to the shores of Japan seems to have become reduced in the last few years, and as a result the fishermen had to go farther afield; but towards the end of the War it was difficult to do so because they could not get sufficient fuel to carry their boats far out to sea. Therefore, the only food in which Japan was seriously reduced was protein, and while this is scarcely likely to have very much effect on the adult population, it will affect the children and adolescents. A considerable amount of food used to be imported from Formosa to the homeland.

The eighty millions of Japanese people live on about 150,000 square miles of land. The official population density is given as 374 people per square mile. A very high proportion of the population is engaged in food production, owing to the small-farm system and its wasteful use of labour. Even the introduction of mechanization would be difficult owing to the topography of the country. It should be noted that even with the intensive farming of the last ten or fifteen years Japan proper has not been able to reach a self-sufficiency in food. Even with her colonies she was only able to reach a 99 per cent sufficiency. Presumably Japan's colonies will now be removed from her jurisdiction and at the same time her industrial development will be stifled so that she will not be able to make the engines of war. The Japanese people will not be able to obtain enough food once their colonies have gone unless they can import food, and they will certainly not find any country willing to send them food unless they receive adequate payment by means of useful imports from Japan. Japan will no doubt be permitted light industries, but Japanese goods will receive a poor welcome for some time to come in most countries. If Japanese colonies are taken from her then food will have to be sent to her to save her eighty millions from starvation. While this is no plea that Japan should retain her colonies, the above fact must be faced and any plan for the future nutritional well-being of the world must take eighty million Japanese into account.

OXIDATION

THE Faraday Society has had the courage, in spite of the very few months of peace, to initiate without delay its pre-war discussions on a pre-war scale. The meeting to discuss "Oxidation" held during September 27 and 28 brought forth all the vigour of previous discussions, and demonstrated how keen chemists are to exchange ideas and to subject each other to searching criticism in a way only the Faraday Society can achieve.

The field of oxidation is so wide that it was somewhat difficult to define specific topics under such a broad heading. Nevertheless, the papers contributed to the meeting fell under three main headings, namely, (*a*) oxidations involving electron transfer processes and occurring therefore mainly in aqueous media, (*b*) liquid-phase oxidations mostly of hydrocarbons, and (*c*) high-temperature and gas-phase oxidations. Much work has recently been done at low temperatures in the liquid phase which has led to a deeper understanding of the mechanism of these processes. For the interpretation of such reactions it has, of course, been necessary to borrow very freely from the theory of thermal chain reactions, so that in a way no really new fundamental hypothesis has been necessary. Further, much of the technique has been in existence many years awaiting application whenever suitable systems could be found. It is worth while recalling that the whole subject of chain oxidations was started experimentally by the pioneering work of H. J. L. Backstrøm. The surprising thing is that all this new work was not attempted long ago, for it is twenty years since Backstrøm published his first researches. This does not mean that present developments are devoid of new ideas, because the precise knowledge obtained in studying the oxidation of carefully chosen systems cannot fail to help in the elucidation of the mechanism of the oxidation of drying oils, rubber and many other related but very complex processes.

Oxidation and polymerization processes usually occur by a chain mechanism, and the resemblance is more than formal. It has been known for some time that vinyl monomers can be polymerized in aqueous emulsions if peroxides, persulphates, etc., are dissolved in the aqueous phase. Now it has been shown in the papers of Morgan and Bacon and of Baxendale, Evans and Park that the addition of a reducing agent to the aqueous phase leads to very much higher rates of polymerization. This so-called reduction activation technique brings polymerization and oxidation into very close inter-relationship. If it is assumed that polymerization proceeds by a free-radical mechanism—and there is abundant evidence for this supposition—the problem is to try to understand how the peroxide forms free radicals. A system which gives rise to accelerated polymerization is H_2O_2 — Fe^{++}. According to the Haber–Weiss theory, the first step in this reaction is $H_2O_2 + Fe^{++} = HO$ and $HO^- + Fe^{+++}$. The OH radical normally reacts with more hydrogen peroxide and gives rise ultimately to molecular oxygen. In presence of monomers like methyl acrylate, acrylic nitrile, styrene, etc., the OH radical is taken up to initiate polymerizations, and no molecular oxygen is evolved. In this way, then, hydrogen peroxide decomposition is accelerated; but definite proof is provided that free radicals are involved in the oxidation of Fe^{++} to Fe^{+++}. Thus the familiar Fenton's reagent gets a novel application to a comparatively new branch of chemistry. Morgan and Bacon have investigated a very large number of systems using persulphate, sulphites and thiosulphates. Hydrazine derivatives all show the effect with acrylic nitrile. Not all monomers respond to the treatment; styrene, and particularly butadiene, being exceptions to the more general rule. The kinetics of these reactions indicate termination of polymerization by mutual reaction between free radicals, and consequently the increased speed of polymerization is often accompanied by a decrease in the molecular weight of the polymer.

It is only comparatively recently that detailed knowledge of the mechanism of the oxidation of liquid hydrocarbons has been obtained. The papers contributed to this section of the discussion showed there is much yet to be done, for the experimental results in many cases are in conflict. The final products of oxidation are usually very complex, and hence it would appear that analytical and kinetic methods could not possibly lead to any definite formulation for the mechanism; but by the study of the initial phases of some reactions much light has now been brought to bear on this problem. The main advance has come from the isolation of hydroperoxides as intermediates in the sequence of processes. Thus, in general, the oxidation may be investigated in two parts, namely (*a*) the formation of hydroperoxide, and (*b*) the mode of decomposition of the hydroperoxide into the final products of the reaction. The first stage is amenable to kinetic investigation. Gee and Bolland have shown that peroxides can be isolated in the oxidation of unsaturated hydrocarbon chains in ethyl linoleate, ethyl linolenate, methyl oleate and squalene.

$$(CH_3)_2C{=}CH.CH_2(CH_2.C(CH_3){=}CH.CH_2)_2{—}$$
$${—}(CH_2.CH{=}C(CH_3)CH_2)_2CH_2.CH{=}C(CH_3)_2.$$

Robertson and Waters have studied in detail the autoxidation of tetralin, and George and Robertson have investigated the heavy-metal and the surface-catalysed oxidation of tetralin. The formation of hydroperoxides is certainly a chain reaction, and practically all investigators agree that the reaction goes by way of free radicals thus:

$$R.OO. + RH = R.OOH + R.$$
$$R. + O_2 = RO_2^-,$$

the chain carriers thus being the free hydrocarbon radical and the peroxide radical. The hydroperoxide *R*OOH then decomposes according to first- or second-order reactions, depending upon its nature. The real difficulty is to try to understand how the oxidation is started, and how the free radicals are removed from the system when inhibitors are absent. The normal method of removal might be the combination of *R* or *R*.OO, depending upon which was present in the greater concentration, but there is evidence that this kind of removal is not always operative. In the absence of positive catalysts, these oxidations exhibit induction periods during which the peroxide content of the liquid rises. This can only mean that the decomposition of the peroxide itself gives rise to free radicals which start off the chain of events. Moreover, it is known from other work that free radicals are produced during thermal decomposition of peroxides, and the addition of peroxides like dibenzoyl peroxide eliminates the induction period. These observations do not, however, give a clue to the manner in which the thermal oxidation initially starts. It is easy to postulate that the hydrocarbon *R*H simply dissociates to *R* and H, but this would in general require a prohibitive amount of energy.

It would seem that molecular oxygen must attack the hydrocarbon in some way such that a free radical ultimately emerges from the reaction, but no reliable information has yet been gained on this point. Bolland and Gee reported a series of thermo-chemical measurements on such oxidation reactions which were designed to prevent the formulation of energetically impossible mechanisms. This is, of course, a very necessary complementary approach to the kinetic attack.

These fundamental experiments open the way to the interpretation of the mechanism of the oxidation of hydrocarbon lubricating oils (C. B. Davies), the oxidation of coal (Jones and Townend) and the oxidation of rubber (Horrabin, New and Taylor). Similarly they are of the greatest interest in connexion with the relationship between knock rating of a fuel and its chemical constitution. The link-up between the two types of investigation is far from complete, but Walsh has reviewed the subject and come to the conclusion that in the formation of peroxides from hydrocarbon fuels tertiary CH bonds are most prone to attack, while secondary CH bonds come next and then finally primary CH bonds.

Catalytic oxidation of hydrocarbons does not always give rise to the hydroperoxides. G. H. Twigg described the oxidation of ethylene to ethylene oxide on a silver catalyst. This is a specific catalysis of great interest, for there are many possibilities for reaction. In these circumstances it would appear that oxygen atoms are adsorbed on the silver surface, and that ethylene molecules are then directly oxidized to the oxide. Furthermore, ethylene oxide may even be reduced when put into contact with a clean silver surface. In addition, ethylene oxide may isomerize to acetaldehyde, and if conditions are not rigidly controlled ethylene may be oxidized directly to carbon dioxide and water without going through the intermediate stage of ethylene oxide.

The third part of the discussion dealt with gas-phase oxidations, including explosive phenomena. Gas phase oxidations have been studied kinetically since the theory of branching chains was first put forward. The study of stable and explosive chain kinetics have in many cases established generally what types of collision occur in these complex reactions. It is often possible to say what is the kinetic order of the initiation process and also to say which molecule—the oxygen or the hydrocarbon—is involved in the rate-determining step. In addition, it is possible to say whether the chain carrier disappears at a rate proportional to the first or to the second power of its concentration. Suitable experiments show whether this reaction occurs at the surface of the reaction vessel or in the gas phase, but unless it is practicable to measure the numerical values of the velocity coefficients, kinetic data alone can give no certain clue to the real nature of the chain carriers. The ideal to be aimed at is to identify these carriers and to measure their stationary concentration. A number of papers indicated the way in which this kind of exacting research can be started.

Identification is the first step. Gaydon has made the important observation that the addition of small quantities of nitric oxide to a flame gives rise to a yellow-green luminescence, which is due to the addition of oxygen atoms to the nitric oxide molecule. Although this reaction only occurs infrequently, the rate is sufficiently high to give rise to a detectable intensity of radiation. The luminescence can thus be used as a detector of oxygen atoms in flames; and moreover the relative intensity gives an indication of the relative concentration of the oxygen atoms. Further, by using a Smithell's flame separator, the existence of oxygen atoms can be investigated in composite flames of burning hydrocarbons. In such circumstances the inner cone shows no atomic oxygen while the outer gives the strong characteristic luminescence of the NO_2 molecule. Similarly, flames of hydrogen and of carbon monoxide give strong emissions indicating high concentrations of atomic oxygen. The difficulty is to find whether the atomic oxygen does in fact act on a chain carrier, for it is quite possible, for example, in the hydrogen–oxygen reaction, that processes like $H + O_2 = HO + O$ are the sources of oxygen atoms, although the main chain carriers are H atoms and OH radicals.

Further evidence for the existence of oxygen atoms comes from the work of Dooley and Whittingham, who have shown that traces of SO_2 are formed in many flames. There seems little doubt that the reaction responsible is direct oxidation, $O + SO_2 = SO_3$, since there is reason to suppose this reaction can occur directly with a low probability. The detection of SO_3, or rather of sulphuric acid, is done in an ingenious, sensitive and simple manner by allowing the gases to impinge on a cool glass surface on which are embedded two thermocouples. The dew point is measured by noting the temperature at which the current passes between the two couples, thus indicating the presence of a conducting film of sulphuric acid on the surface of the glass.

A further study by Dainton and Bevington of the oxidation and formation of yellow phosphorus again emphasizes the role of atomic oxygen in this reaction and its relationship to the low-temperature luminous oxidation of phosphorus vapour.

Topps and Townend described the spectroscopic approach to the determination of the nature of active intermediates. Outside the normal explosion limits of substances like ethers, aldehydes and higher hydrocarbons, particularly at low temperatures, the oxidation is accompanied by emission of luminescence —the so-called cool flames. Spectroscopic examination of the luminescence shows it to be identical with the fluorescent spectrum of formaldehyde excited by ultra-violet light. Intensity measurements show that the efficiency of the emission process is extremely small, about 10^{-6} for acetaldehyde. It is of interest to note that the formaldehyde is undetectable chemically. The mechanism whereby the formaldehyde molecules acquire sufficient energy to radiate is obscure. The full elucidation of the thermal oxidation would be particularly valuable in this case but it is limited by the information provided from a study of the kinetics alone. Style and Summers have therefore studied the photochemical oxidation up to temperatures at which the thermal reaction proceeds at a comparable speed. Thus additional information is obtained about the reaction, since there is sufficient knowledge about the photochemical decomposition of formaldehyde to enable various factors in the thermal oxidation to be measured more precisely. This type of approach is bound to be fruitful when it is applied to a larger range of molecules.

In quite another category is the combustion of solid fuels. It might be thought, in view of the immense amount of effort given to the study of the subject, and to the vast practical experience of the construction of furnaces, that no advance could now usefully be made. M. W. Thring showed how fallacious this conclusion can be by a description of the

fundamental work leading to the development of the so-called down-jet furnace. In all normal fuel beds, a considerable amount of carbon monoxide is emitted from the top surface, and thus secondary air must be fed into the combustion chamber to burn the fuel completely. The reason for the production of carbon monoxide is the practical limitation that the bed must be deep enough to prevent any serious amount of channelling, whereby oxygen is not then completely consumed. Carbon dioxide produced in the initial stages of combustion is therefore inevitably reduced to carbon monoxide, which must be re-oxidized. The maximum attainable temperature from a fuel is therefore never attained. In the down-jet furnace, the air stream is directed downwards to the fuel bed, and in this way the depth of the combustion layer is kept at a minimum, with the result that an intensely hot flame is produced and the carbon dioxide content of the issuing gas is high. The paper described the various difficulties overcome in putting the principles to work in an actual furnace. A novel development of this type is bound to open wide fields of researches connected with chemical processes at temperatures hitherto unattainable by conventional furnaces burning carbonaceous fuels in the presence of air.

H. W. MELVILLE.

NATIONAL FLOUR (80 PER CENT EXTRACTION) AND BREAD IN BRITAIN

Eighth Report from the Scientific Adviser's Division, Ministry of Food

THE present report covers the two periods June 18–August 11 and October 8–December 15, 1945; during this time, 4,334 samples of National 80 per cent flour were examined. Examination of the samples followed the same lines as described in previous reports on National flour (cf. ref. 1); individual samples were examined in respect of colour index (bran speck contamination), granularity, baking quality, vitamin B_1 and *creta præparata* content, while ash, fibre, *creta*, iron, nitrogen and nicotinic acid were determined on fortnightly composite samples in which the individual samples were blended according to the size of the mill by which they had been manufactured. (Riboflavin figures have not been included in this survey partly because the microbiological technique, which is the method in general use in these laboratories, has not given consistent results and also because satisfactory agreement with biological methods has not yet been established. The microbiological estimation of nicotinic acid, on the other hand, appears to be generally satisfactory.) National average figures on sample and capacity bases were calculated from results obtained on these composite samples. Data concerning the average composition of the grist used in milling the flour and of the quantities and kind of imported flour admixed were compiled from the information accompanying the survey samples, sent by the millers.

Composition of the Grist and Average Protein Content

Since the end of the period covered by the previous report on National flour[1], the proportion of home-grown wheat in the grist has decreased to half its former value. A temporary increase in the amount of Plate wheat was followed by a considerable increase in the proportion of Manitoba wheat, which now averages 77 per cent of the total grist. The fluctuations in protein content of the grist closely follow the changes in the proportion of Manitoba wheat, as shown by the data in Table 1:

TABLE 1. AVERAGE COMPOSITION OF GRIST (CAPACITY BASIS) AND PROTEIN CONTENT OF SAMPLES ANALYSED.

Fortnight beginning	Average composition of grist			Average protein content, per cent (=N×5·7)
	Manitoba (per cent)	Home-grown (per cent)	Plate and other (per cent)	
Jan. 22	58·5	35·4	6·1*	11·8
April 2	61·2	35·7	3·1	11·9
June 18	56·7	37·1	6·2	11·8
July 2	56·3	36·6	7·1	—
July 16	52·4	38·3	9·3	11·6
July 30	53·8	37·4	8·8	—
Oct. 8	67·1	28·3	4·6	12·0
Oct. 22	74·4	21·8	3·8	—
Nov. 5	76·8	18·7	4·5	—
Nov. 19	76·0	18·8	5·2	—
Dec. 3	77·3	18·8	3·9	12·4

* Including 0·2 per cent of rye and barley.

Addition of Imported White Flour

Approximately 15 per cent of imported white flour was added at the mill to all National flour manufactured during the period June 18–August 11. Thereafter the average rate of addition was reduced to 5 per cent. The source of this imported flour was as shown in Table 2.

TABLE 2. SOURCE OF IMPORTED WHITE FLOUR.

Fortnight beginning	Average rate of addition				Total (per cent)
	American (per cent)	Canadian (per cent)	Plate (per cent)	Australian (per cent)	
June 18	2·0		12·9		14·9
July 2	2·5	11·9	0·2	0·4	15·0
July 16	1·9	11·9	0·4	0·7	14·9
July 30	1·7	11·3	0·9	1·1	15·0
Oct. 8	0·2	4·4	0·2	0·7	5·5
Oct. 22	0·1	4·4	0·2	0·6	5·3
Nov. 5	0·4	3·9	0·4	0·8	5·5
Nov. 19	0·4	4·1	0·2	0·8	5·5
Dec. 3	0·1	3·9	0·8	0·8	5·6

Colour Index and Granularity

A summary of the colour index (bran speck contamination) data is given in Table 3. The colour index value expresses the speckiness as a percentage of that of an average 85 per cent National flour (colour index value 100). A flour with a colour index value of 0 would therefore be entirely free from visible bran specks. The speckiness has shown a slight temporary increase during the period under consideration. The fineness of grinding of the flour has remained markedly constant; sifting tests on 1,010 samples examined during the last four weeks of the period show that the average percentage weight of the sample which, under standard conditions, does not pass through the No. 10 standard bolting silk is 7·45 per cent as compared with 7·3 per cent in the previous period, February 2–May 5, 1945[1]. The mode, or most frequently occurring value, has, however, decreased from 5·5 to 3·7 per cent, while the range of values encountered (0–41 per cent) is slightly wider.

Vitamin B_1

Fortnightly average values for vitamin B_1, on sample and capacity bases, together with the fre-

TABLE 3. SUMMARY OF COLOUR INDEX (BRAN SPECKINESS) DATA.

Colour Index not exceeding	Percentage of all samples examined in weeks commencing								
	June 18	July 2	July 16	July 30	Oct. 8	Oct. 22	Nov. 5	Nov. 19	Dec. 3
5 units	7	9	9	5	5	7	10	10	6
10 ,,	29	30	24	21	19	31	32	40	34
15 ,,	55	51	42	40	42	52	53	56	59
20 ,,	68	67	67	58	67	68	70	75	75
30 ,,	80	81	83	79	85	85	84	88	84
40 ,,	90	91	93	90	91	92	92	93	90
50 ,,	98	97	97	97	97	97	95	97	96
70 ,,	100	99	99	99	99	99	99	98	98
Average Colour Index									
Sample basis	21·3	21·6	22·2	23·8	22·8	21·6	21·1	19·7	21·0
Capacity basis	15·2	15·2	15·9	17·3	17·8	15·6	14·4	13·5	14·2
No. of samples examined	243	233	232	232	245	246	247	248	259

TABLE 4. SUMMARY OF VITAMIN B_1 DATA.

Vitamin B_1 (I.U./gm.) not less than	Percentage of samples in fortnightly periods commencing									Average for 18 weeks
	June 18	July 2	July 16	July 30	Oct. 8	Oct. 22	Nov. 5	Nov. 19	Dec. 3	
1·0	1	3	1	1	1	2	2	3	2	2
0·95	2	6	1	2	4	4	3	5	2	3
0·9	15	10	7	4	8	11	7	8	7	9
0·85	26	19	14	9	19	23	23	23	16	20
0·8	46	39	36	27	41	40	38	46	36	39
0·75	70	62	55	59	65	61	64	63	58	62
0·7	85	77	79	87	80	78	81	81	79	81
0·65	93	87	88	96	89	86	92	89	88	90
0·6	98	94	94	98	95	92	97	93	94	95
Average B_1, I.U./gm.										
Sample basis	0·79	0·77	0·76	0·76	0·77	0·77	0·77	0·77	0·76	0·77
Capacity basis	0·81	0·79	0·76	0·76	0·79	0·78	0·77	0·78	0·77	0·78
No. of samples analysed	198	196	199	179	196	217	204	190	188	196
Per cent of total capacity represented	87	86	88	82	88	91	90	88	87	87

TABLE 5. FIBRE, ASH, CRETA, NICOTINIC ACID AND IRON IN NATIONAL FLOUR: CAPACITY BASIS (FROM ANALYSIS OF COMPOSITE SAMPLES).

Fortnight commencing	June 18	July 2	July 16	July 30	Oct. 8	Oct. 22	Nov. 5	Nov. 19	Dec. 3	Average for 18 weeks
Fibre, per cent	0·23	0·20	0·17	0·20	0·21	0·19	0·20	0·17	0·20	0·20
Ash, per cent*	0·72	0·69	0·67	0·70	0·67	0·66	0·63	0·66	0·65	0·67
Creta, oz./sk.	4·6	4·5	5·5	4·9	5·4	5·2	7·1	6·9	7·2	5·7
Nicotinic acid, p.p.m.	16·8	16·2	18·0	17·8	15·4	17·0	15·2	**15·7**	**14·9**	16·3
Iron, p.p.m.	17·0	15·8	15·9	16·0	15·9	15·3	15·2	15·9	**15·4**	15·8

* Corrected for added *creta*. The statutory addition of 7 oz. of *creta* per 280 lb. sack of flour increases the ash content by 0·12 per cent.

quency distribution of the individual values, are shown in Table 4.

Although the National average figure for B_1 is sensibly constant, there is a fluctuation in the vitamin B_1 content of the flour produced by any particular mill; consecutive determinations over a number of weeks showed that for 269 mills the average range of fluctuation was 0·14 I.U./gm. This may be due in part to variation in the vitamin B_1 content of the wheat.

The lowest two values were found in the periods commencing July 16 and July 30, when the percentage of Manitoba wheat in the grist was least. Otherwise there is no correlation between vitamin B_1 content of the flour and the composition of the grist.

Analysis of Fortnightly Composite Samples

The analytical data obtained from the fortnightly composite samples are presented in Table 5. They are corrected for added white flour.

In the report of the Conference on the Post-War Loaf[2], a recommendation is put forward (par. 32) that flour should contain the following minimum quantities of three token nutrients:

Nutrient	Quantity
Vitamin B_1	0·24 mgm. per 100 gm.
Nicotinic acid	1·60 ,, ,, ,,
Iron	1·65 ,, ,, ,,

On referring to Tables 4 and 5 above, it will be noted that the National average figures found for vitamin B_1, nicotinic acid and iron in the period under survey have been 0·234, 1·66 and 1·58 mgm. per 100 gm. respectively.

Quality of Bread

Loaves baked from National Flour Survey Samples.

During the period under consideration, 448 samples of flour were baked under ideal conditions in the laboratory and the resulting loaves judged for volume, colour and quality of crumb, and were classified as follows:

Quality of bread	Number of loaves	Per cent of total
Good	322	71·8
Fair-good	70	15·6
Fair	43	9·6
Poor	13	2·9

Survey of Commercially Baked Bread

During the period May 7–August 31 (when this commercial bread survey ended) 1,016 samples of bread purchased from bakers in different parts of Great Britain have been examined and judged (commercial standards) with the following results:

Quality of bread	Number of loaves	Per cent of total
Good	116	11·4
Fair-good	497	49·0
Fair	304	29·9
Poor	99	9·7

This work has been carried out at the Cereals Research Station, Ministry of Food, St. Albans.

[1] *Nature*, **155**, 717 (1945).

[2] Report of the Conference on the Post-War Loaf, 1945. Cmd. 6701. (London: H.M. Stationery Office, 1945.)

LAKE TANGANYIKA

By R. S. A. BEAUCHAMP

THE fauna of Lake Tanganyika has aroused great interest on account of its abundance of species, many of which are found nowhere else. The hydrological features of the Lake are no less remarkable and provide an explanation for the evolution of so many 'endemic' species. The Lake also offers exceptionally suitable material for studying a number of problems of general hydrobiological significance.

Lake Tanganyika, situated just south of the equator, is 650 km. long, approximately 60 km. wide and 1,500 metres deep. Probably the oldest lake in the world, it apparently has had no outlet until about 15,000 years ago, when it received the waters of the River Ruzizi. The Ruzizi drains Lake Kivu, which was formed as a result of volcanic upheavals. The Ruzizi is one of the larger inflows of Tanganyika, but even now the outlet from the Lake is small and intermittent. Evaporation accounts for ninety-five per cent of the total annual loss of water at the present time, yet the total salt concentration of the lake water is no more than 420 parts per million—an amount normal for lake waters. This may be explained by the facts that the inflows are of small volume and low salt content, and that rain falling directly on to the Lake accounts for two thirds of the total water supply.

The inflows amount annually in volume to little more than one two-thousandths of the volume of the Lake, and their average salt content, excluding the Ruzizi, is approximately 150 p.p.m. Thus before the entrance of the Ruzizi it would have taken approximately 2,000 years to increase the total salt content of the Lake by 150 p.p.m., if no biological precipitation of mineral matter occurred. But this occurs in all lakes; the bottom deposits contain the remains of plants and animals, the bodies of which are built up from minerals previously in solution. The precipitation of silica by diatoms and calcium by molluscs clearly demonstrates the principle, which applies to some extent to all the mineral constituents of living bodies, but least of all to the very soluble salts of potassium and sodium. At the same time decomposition of the bottom deposits is gradually liberating these minerals; but in no lake does this process keep pace with the precipitation of organic matter, which is continually accumulating. In Tanganyika it appears that precipitation roughly balances both the small amounts of mineral matter brought in by the inflows, and the amount liberated by decomposition of the bottom deposits. This fact not only helps to explain the unexpectedly low concentration of salts in the Lake, but also the very unusual composition of the Lake water.

Table 1, col. 3, shows amounts, expressed as parts per million, of the constituents of the Lake water from samples collected from 700 m. (the average middle depth of the Lake).

Table 2 shows the values for chloride and sulphate, and for magnesium and calcium expressed as ratios, and for comparison these ratios as they occur in the inflows and in sea water. It will be seen that the relative proportions in the Lake water are quite dissimilar from those in the inflows, but similar to those in sea water. The proportions in the inflows are, however, normal for fresh waters. It appears that biological processes have, over the very long period the Lake has existed, produced these alterations in the chemical composition of the Lake water. This may provide a partial explanation for the large number of 'endemic' species found in the Lake, many resembling marine types. It has been suggested that these may have evolved at a time when the Lake was shallower and more salt. But it seems certain that, before the Ruzizi flowed into the Lake, the concentration of salts was even less than at the present time, because this river now supplies the Lake with about a quarter of its incoming salts. It provides approximately 13 per cent of the inflowing water and its salt content is four times as high as that of the other inflows. Thus unless the Lake was reduced to a very small size during arid periods, the salt concentration was probably never very high.

TABLE 1.

	Inflows	Tanganyika 700 m.	Factor
Sodium	25·0 p.p.m.	64·2 p.p.m.	2·57
Potassium	9·0	33·5	3·7
Lithium	0·28	0·8	3·0
Calcium	19·0	15·2	0·76
Magnesium	17·2	43·7	2·5
Iron	<0·1	<0·1	1·0
Aluminium	0·3	0·3	1·0
Chloride	14·0	28·0	2·0
Sulphate	8·2	4·0	0·5
Nitrate	1·5	1·8	1·2
Nitrite	0·003	0·006	2·0
Phosphate	0·06	0·6	10·0
Silicate	26·0	13·5	0·5
Carbonate	100·0	207·6	2·0
Total	220·6	413·3	

TABLE 2.

	Inflows	Tanganyika	Sea Water
Chloride to sulphate	1·7 – 1	7 – 1	7·17 – 1
Magnesium to calcium	0·9 – 1	2·9 – 1	3·19 – 1

Table 1 summarizes the present data on the chemical composition of the inflows and lake water of Tanganyika. The average values for the inflows are based on analyses made from nine inflows, including three major ones. The last column contains factors relating the concentration of the ions in the inflows to their concentration in the Lake. The more a particular ion has been utilized and removed from circulation, the lower the factor. In this connexion it should be noted that, if it were not for biological precipitation, the concentration of salts in the Lake would presumably by now have reached saturation point. It is evident that even soluble ions such as sodium and potassium and chloride are retained permanently in the bottom deposits.

Tanganyika possesses a marked degree of thermal stability, a very unusual feature in a tropical lake. Below 400 m. the temperature of the water remains constant at 23·1° C. and appears to be unaffected by temperature changes or currents in the upper layers. A well-defined thermocline, at depths varying from 40 m. to 100 m. in different parts of the Lake at different seasons, is present for about eleven months of the year. Some exchange of water occurs between the epilimnion and the top 300 m. of the hypolimnion, but normally no oxygen is found below the thermocline. The persistent nature of the thermocline is illustrated by the condition of the lake mud; below about 80 m. it is of very fine consistency and black; above this level it is composed of larger particles and is grey in colour.

An important reason for the thermal stability of the Lake appears to be that the inflowing waters, which are cooler than the surface waters of the Lake,

flow down the steep littoral region until they reach levels below the thermocline, thus maintaining the lower temperature of the deep water. A notable example of this is the Ruzizi. The formation of this inflow was probably an extremely significant event in the history of the Lake. Not only did it raise the level of the Lake and give Tanganyika an outlet, but also it probably very greatly reduced the productivity of the Lake by making its waters more stable. The abundance of empty shells on the beaches and the present apparent paucity of the molluscan fauna lends support to this theory. The oligotrophic nature of the Lake is due to its thermal stability, yet it is potentially very productive. Locked up in the hypolimnion are all the nutrient salts to support a prolific flora and fauna.

This storage of nutrient salts in the hypolimnion indicates a number of ways in which the productivity of this Lake and the surrounding agricultural areas might be increased. Any agency which will affect mixing between the epi- and hypo-limnion will have an immediate beneficial effect on the Lake. This might be achieved mechanically in suitable localities or by irrigational schemes designed primarily to benefit agriculture. At the present time the inflows, rich in nutrient salts, are to a large extent unused, since they tend to enter the Lake at levels below the thermocline. If these inflows were used for irrigation, their temperature would be raised and their waters could then mix with the surface waters of the Lake, thus not only making their salts available, but also reducing to some extent the thermal stability of the Lake. In addition, the drainage of low-lying areas and the fertilizing of these areas with the rich bottom deposits of the Lake would again benefit both agriculture and the fisheries, and would also improve the malarial situation. It is to be hoped that developments along these lines may one day be carried out.

The conditions obtaining in Tanganyika are ideal for studying the chemical factors which limit and control plankton development, since for considerable periods the thermocline is so well differentiated that the epilimnion is depleted of nutrient salts and the plankton so reduced that prolonged tow-netting yields only insignificant quantities. At other times seasonal variations in temperature, or changes in the strength and direction of the wind and internal wave (temperature seiche) effects, cause mixing between the surface and deep water which leads to considerable variations in the amounts of nutrient salts in the epilimnion. However, during the year, the temperature of the epilimnion varies little more than 3° C. (from 23·5° C. to 26·5° C.), and since the Lake lies close to the equator the seasonal variation in the amount of light falling on it is slight. Thus the effects of change in the chemical composition of the water can be studied in the absence of confusing alterations in light and temperature. The exceptional suitability of this Lake for such investigations is apparent when one considers some of the difficulties met with in other tropical lakes and also in temperate lakes. In other tropical lakes thermal instability prevents complete utilization of the nutrient salts in the surface waters, so no estimate can be made of the limiting values of these salts; while in temperate lakes, which are thermally stable during the summer, the reduction in temperature and light during the winter, as well as the constant daily fluctuations in light, superimpose other factors which limit plankton development and prevent a proper evaluation of the effect of change in the composition of the water.

In Tanganyika changes in the hydrology of the Lake may at times be marked by very obvious changes in its biology. At the end of the cool season there is a well-recognized drift in the 'dagaa' fishery from the south end of the Lake towards the north end. The 'dagaa' are small plankton-feeding fish. At the same time the Tanganyika jelly-fish makes its appearance at the south end of the Lake and later is found farther and farther north. These events express in a most striking manner the effect of mixing between the surface and deeper waters of the Lake. At this season there is a gradual fall in the temperature of the surface water, greatest towards the south, so that while it may be 25° C. at the north end, it is only 23·5° C. at the south end. As a consequence the thermocline occurs at lower and lower levels and becomes less well defined, until in the shallower waters at the south end of the Lake it ceases to exist and very considerable mixing occurs with the deeper water rich in nutrient salts. There is then an immediate and abundant development of the plankton. The prevailing wind, which at this season is from the south, drifts this more productive water northwards. These happenings are brought to an end by the onset of the warmer weather, which is marked by a change in the wind, which now tends to blow from the north. This change in wind direction, however, has one further disturbing influence on the Lake; by changing the direction of the currents in the epilimnion, frictional disturbances arise at the level of the thermocline and bring about further mixing. From then on, more stable conditions arise, and continue, with minor changes, throughout the warm season.

Quite apart from biological studies on this Lake, which have scarcely been started, an immense amount of hydrological work remains to be done and should yield results of quite exceptional interest and value; for they will not only help towards reaching an understanding of Tanganyika and its many problems, but will also advance appreciably our knowledge of the basic principles of hydrobiology.

A list of references to work on Tanganyika is given in a paper by me published in 1939 but not readily available (*Int. Rev. Hydrobiol.*, **39**; 1939), which also contains a more detailed account of the hydrology of Lake Tanganyika.

OBITUARIES

Prof. E. S. Goodrich, F.R.S.

Edwin Stephen Goodrich was born on June 21, 1868, at Weston-super-Mare and died at Oxford on January 6. He was brought up in France, spoke French like a Frenchman, and always remained a great admirer of that country. After returning to England he entered University College, London, in 1888, and it was while studying there as an art student at the Slade School that he heard some public lectures given by Ray Lankester and realized that zoology was his proper profession. He became assistant to Ray Lankester, and when the latter went to Oxford to become Linacre professor of zoology and comparative anatomy, Goodrich followed him. He entered Merton College as a commoner in 1892, and ultimately became a fellow and a professorial fellow of the same College, when he succeeded to the Linacre professorship in 1921. He always prided himself on his undivided allegiance to Merton, and it must have been a source of great satisfaction to him

when, a month before his death, he was made an honorary fellow of Merton.

In zoology, Goodrich's interests were primarily those of a comparative anatomist, in which field he can without exaggeration be claimed as the greatest in the world of his day. There was scarcely a group of the animal kingdom to which he did not devote his attention, or to which he did not make a lasting contribution to knowledge. His first paper was published in 1892, and in the following year he started the remarkable series of papers in which he unravelled the problems of the structure and development of the nephridium and of its distinction from the coelomoduct. This line of work led him to study the structure and development of most of the forms in which nephridia occur, especially the Annelida and *Amphioxus*, and to determine the relations of the coelomic cavity, in molluscs, arthropods and the Actinotrocha larva of *Phoronis*, to mention only a few. He also investigated the systematic position of the Archiannelida in the light of his researches into their structure and development. For the series of text-books on zoology edited by Ray Lankester, Goodrich contributed the section on the holothurioid echinoderms, and the volume on fish. This last work, which was almost entirely based on personal investigation and verification of all facts contained in it, marked an epoch in the study of fish, and through them, of all higher vertebrates. Goodrich clarified the puzzle of the different types of so-called ganoid scales and enabled fossil forms to be compared profitably with living ones. His interest in fossils was indeed no new one, for among his earliest works was a paper on the fossil mammalian jaws from Stonesfield, to which later workers have been able to add very little. He investigated the segmentation of the heads of amphibians and selachians, which paralleled for vertebrates the work which he had done in invertebrates on the segmentation of the arthropod head.

Goodrich's "Studies on the Structure and Development of Vertebrates", a large book in which every item was either a result of his own work or was checked by him, is a monument of accuracy, completeness and clear exposition.

His mastery of analytical detail in so many groups enabled Goodrich to make synthetic studies of subjects of general application, such as the relations between metameric segmentation and homology, or the 'faithfulness' of motor nerves to their segmental muscles.

While his predilection for morphological studies may have led some of his contemporaries and juniors to consider him as old-fashioned, Goodrich was always keenly interested in the progress of genetics and experimental zoology, and his acuteness enabled him to cut right through fallacies, some of very old standing, like a knife. He regarded all the changes undergone by an organism during its development as responses to stimuli, some internal (and hereditary) and some external. This point of view not only rendered him appreciative of the results of experimental embryology, but also enabled him to demonstrate the illogicality of the expression 'inheritance of acquired characters' and of Lamarckian hypotheses of the causation of evolution.

From 1915 until 1923 Goodrich was zoological secretary of the Linnean Society of London. In 1921 he began his association with the *Quarterly Journal of Microscopical Science*, which continued until his death; and all contributors will remember the personal interest which he took in every communication submitted to him, and the helpful suggestions which so frequently increased the value of the paper.

His early training in art served Goodrich in good stead throughout his life. Not only were the illustrations to his papers and his drawings on the blackboard while lecturing really beautiful, but also he had a genuine gift for landscape painting in water colour. He travelled all over the world and always brought back with him a set of pictures, striking alike for their draughtsmanship, composition and colouring. Some of them were shown by him at exhibitions in Bond Street, London.

In 1913 he married Dr. Helen L. M. Pixell, and he collaborated with her in researches on Protozoa.

Goodrich was elected into the fellowship of the Royal Society in 1905 and was awarded a Royal Medal in 1936. He received the Linnean Medal in 1932. In addition to his Oxford degree of D.Sc., he was an honorary LL.D. Edinburgh, honorary D.Sc. Dublin, and a foreign or corresponding member of the New York Academy of Sciences, the Swedish Royal Academy of Sciences, the Academy of Sciences of the U.S.S.R., the Belgian Royal Academy, and the Paris Society of Biology.

As a man of science, Goodrich attained the highest standard, but no record of him would be complete without paying tribute to the quiet unassuming charm and loyal friendliness which distinguished him as a man.

G. R. DE BEER.

Academician V. L. Komarov

VLADIMIR LEONTIEVICH KOMAROV died on December 5, 1945, in his seventy-seventh year. He was the doyen of systematic botanists in Russia, ex-president of the Academy of Sciences, a deputy of the Supreme Soviet, and holder of the highest Soviet civil award—a Hero of Socialist Labour.

Komarov was born in St. Petersburg in 1869, and was educated at the University there. He was a younger contemporary of Mendeléeff and Timiriazeff. He set out at an early age on a life of exploration, plant collecting, and systematics; and throughout his career these remained his interests in botany. For some years after graduation he collected material; then followed a series of memoirs on regional floras and studies of separate genera, carried out with a thoroughness and precision which put him in the front rank as an investigator. His travels ranged from Manchuria to Turkistan; and his researches from taxonomy to evolution and anatomy.

Komarov had a forceful, vigorous personality and advanced political opinions; accordingly he was chosen after the October Revolution to be one of the leaders of science in the new Soviet Union. He threw himself with great energy into this task, and he welcomed the increased opportunity for exploration and scientific research. As early as 1914 he had been made a corresponding member of the Academy. In 1919 he was given the chair of botany at Petrograd; and in 1920 he was elected an academician. His outstanding leadership was recognized by his election as vice-president of the Academy in 1930 and president in 1936. During the last ten years Komarov has organized and edited the splendid "Flora of the U.S.S.R.", which has now reached its tenth volume, and which it is planned to complete in twenty-four volumes by 1948.

During his term as president, Komarov organized the very important war-time activities of the Acad-

emy. Although his health was failing, he maintained his position as leader of science in the U.S.S.R. up to the time of his retirement, after the celebrations of the Academy in June of last year. These celebrations were an occasion for congratulating Komarov on his service to Soviet science, and for summarizing his life-work. In the Botanical Institute named after him in Leningrad there was an exhibition of maps and photographs illustrating his travels. Despite his illness, Komarov attended the sessions of the Academy, and was admitted to foreign membership of the Linnean Society at one of its meetings. Shortly after these celebrations he retired to a rest home near Moscow.

Even in the last year of his life, Komarov displayed an almost child-like enthusiasm for systematic botany and exploration, and on one occasion cross-examined me in a very impressive way for two hours about the vegetation of eastern Australia.

The honour in which Komarov was held by the Soviet Government is shown by the decree of the Council of Peoples' Commissars to perpetuate his name. The decree includes provision of pensions for his widow and his sister; the issue of Komarov's collected works by the Academy; and four scholarships for post-graduate work. E. ASHBY.

Lady Thiselton-Dyer

HARRIET, daughter of Sir Joseph Hooker, granddaughter of Sir William Hooker and of Prof. Henslow the Cambridge botanist, wife of Sir William Thiselton-Dyer, died, ninety-one years old, in her house near Bere Alston a few days before Christmas Day. She had lived in Kew from childhood to ripe age; her father became assistant-director there under his father the year after she was born, and took over the control ten years later. Sir William Hooker's job had been to turn the private garden of a queen into a garden for the nation and the world; Sir Joseph added nobly to its fame and usefulness, and so did Thiselton-Dyer until he too ceased from his labours. His wife made Kew a very hospitable place; for many years a vacant place was set, and was seldom unoccupied, at every midday meal.

After Dyer's retirement in 1905, his wife and he lived in the Cotswolds until his death in 1928; and then she, widowed and old, went down into Devonshire and made a lovely garden of her own. She had an endless knowledge of plants, and an almost magical skill in gardening. Rare and delicate things, *Rosa hemisphærica* for one, grew for her without any trouble at all; *Calceolaria violacea* and *C. tenella* grew rampant over her walls. Fuchsias were one of her latest hobbies; some thirty sorts grew in her garden like weeds, among them the rare *F. erecta*, with its curious upright flowers. She had a Damask rose which she got in her childhood from a very old lady, who had gathered it in Persia in *her* childhood, more than a hundred and fifty years ago. Once upon a time I happened to find *Goodyera repens* growing large and plentiful in a Polish forest; I pressed some between old newspapers and sent them to her as herbarium specimens, but she grew *them*!

Besides her botany, her Hooker ancestry brought her taste and artistic skill; she was an admirable flower-painter, as Sir William Hooker also had been. The very first time I remember seeing her was in her girlhood, some seventy years ago. She was sitting beside Walter Fitch, who had drawn plants for Sir William for many years; and they were both drawing from herbarium specimens, which had been dipped in boiling water until they opened out, wonderfully, into the natural shape of the flower. She inherited other things besides, such as health, strength, untiring diligence and length of days; she was in her garden until not very long before her death. She kept up a large correspondence, for she was a fluent, easy, intimate letter-writer, after the fashion of a hundred years ago. Her friends loved her and looked up to her; she was *très grande dame*. D'ARCY W. THOMPSON.

Prof. A. E. Taylor, F.B.A.

THE death of Prof. A. E. Taylor in the late autumn of 1945 at the age of seventy-five deprived these islands of an illustrious humanist and eminent scholar whose spirited vivacity in writing seemed never to tire; and not these islands only but Europe too, as his honorary membership of the Prussian Academy and of the Accademia dei Lincei partially attested before the War put an end, for the time being, to such graceful glimpses of European comity. Add to this Taylor's eminence as a moralist, his considerable success as a constructive metaphysician in early life and his later high reputation as a liberal defender of orthodox Christianity, and it is plain that the range and variety of his talents was altogether amazing. He excelled in conversation; his letters were literature; and he was very kind.

Taylor's main contribution to straight philosophy, his "Elements of Metaphysics" published in 1903 when he was Frothingham professor of philosophy in McGill University, Montreal, is remarkable for the amount of science, then very new, which he succeeded in incorporating into the somewhat reluctant mould of a metaphysics on F. H. Bradley's lines—non-Euclidean geometry and the labyrinth of the continuum as well as the then more usual excursions into evolution, biology and psychology. This scientific interest, which included proficiency in as well as zest for symbolic methods, remained with Taylor to the end, but found relatively little direct expression except for editing De Morgan's "Formal Logic" in the thirty-five years or thereby during which he taught moral philosophy in Scotland, first at St. Andrews and later at Edinburgh. Then his ruling passion became Platonism and, through Platonism, medievalism, modern ethics and contemporary Christian theology. Burnet's company at St. Andrews had something to do with the Platonism; and Stout, another eminent colleague there, said he found Taylor "ripe for revolt" against the presuppositions of the Common room at Merton (of which College Taylor had been, as Bradley still was, a fellow). In matters of religion no special explanation was needed. The son of a Wesleyan minister, Taylor was always devout, although in Canada he had had a free-thinking phase.

As a Platonist, moralist and theologian, Taylor was especially anxious to maintain that there were great and genuine speculative questions which were extra-scientific in the sense that no answer to them could be 'verified' even 'weakly' by sensory observation. This involved a certain antagonism, very freely expressed, to what he took to be the overweening pretensions of certain men of science; and he was prepared to argue, for example, in "Does God Exist?", a book that came out almost on the day of his death, that there were world-views, not contra-scientific in any way, according to which, for example, the Virgin

Birth presented no really considerable difficulty. There were, however, no traces of obscurantism in his composition, and in his greatest contribution to the study of Greek philosophy, his magnificent "Commentary on Plato's Timaeus", he lavished his powers in seven hundred closely printed pages upon the enigmatic science of that enigmatic dialogue at least as much as upon its equally enigmatic theology, with perhaps too great a profusion of modern analogues but at any rate with a stimulating largeness and infectious ardour that will long survive him.

J. LAIRD.

WE regret to announce the following deaths:

Mr. J. B. Butler Burke, sometime lecturer and Berkeley fellow at Owens College, Manchester, known for his books on the origin of life, on January 14, aged seventy-two.

Dr. M. Nierenstein, reader in biochemistry in the University of Bristol, on January 24, aged sixty-eight.

Dame Ethel Shakespear, D.B.E., known for her geological and palæontological work, on January 17, aged seventy-four.

Dr. Ernest Warren, formerly director of the Natal Museum, on January 29, aged seventy-four.

NEWS and VIEWS

The Great Sunspot and Magnetic Disturbance

A CONSIDERABLE magnetic disturbance in the earth's magnetic field was recorded at the Royal Observatory's Magnetic Station at Abinger on February 7–8. This 'magnetic storm' began abruptly at 10h. 20m. G.M.T. on February 7 and lasted for about 36 hours. It was accompanied by a display of the aurora borealis, obscured in the southern part of Britain by cloud. The ranges of the magnetic elements were: 1·3° in declination; more than 500γ in horizontal force and nearly 400γ in vertical force. The storm was remarkable more for the agitation of the traces rather than for the ranges, which have been exceeded on seven or eight other occasions during the last 11-year solar cycle, 1934–44. This magnetic storm is, with little doubt, related to localized solar phenomena of which the great spot was a notable representative (see *Nature* of Feb. 9, p. 155). At the onset of the storm, the spot group was about 1·9 days (= 25° of solar longitude) past the central meridian. This position of a big spot when a great magnetic storm begins is in general accord with previous statistical results such as those given by Maunder forty years ago.

Solar observations, if available from the United States, India and elsewhere, must be collated and compared with data of radio fade-outs. Reports of fade-outs from Cable and Wireless, Ltd., indicate with a high degree of probability that two intense solar flares occurred on February 6, the day preceding the magnetic storm. The G.M.T. of these fade-outs (03h. 30m., 06h. 20m. and 16h. 15m.–18h. 30m. approximately) precluded solar observations being made in England while these fade-outs were in progress.

Radio-Frequency Energy from the Sun

REPORTS recently circulated in the daily Press to the effect that scientific workers from the Radiophysics Laboratory in Sydney had been successful in receiving radar echoes from the sun and moon are stated by the Laboratory to be completely without foundation. No attempt to establish such contact has been made by the Laboratory. A recent letter from Pawsey, Payne-Scott and McCready, of the Radiophysics Laboratory, Sydney, published in *Nature* of February 9, 1946, reports, however, that 'noises' have been received from the sun as suggested by Appleton (*Nature*, **156**, 534, November 3, 1945); calculations of the apparent temperature have been made and correlation with sunspot activity observed. The Press reports referred to above seem to have been due to a misunderstanding of this work.

Sorby Fellowship: Dr. W. S. Bullough

THE Royal Society has appointed Dr. W. S. Bullough, lecturer in zoology at McGill University, Montreal, to be Sorby research fellow in the University of Sheffield in succession to Dr. K. Mellanby. Dr. Bullough is a graduate of the University of Leeds. While holding first a research fellowship and later a lectureship in the Department of Zoology there, Dr. Bullough carried out investigations on the internal and external environmental control of reproductive cycles in fishes, birds and mammals. His researches on the endocrine glands in relation to bird behaviour throw much light on the reality of the distinction between British and Continental races of starlings, and evidence has been adduced for regarding Continental immigrant starlings as carriers of foot and mouth disease, responsible for outbreaks in British cattle. An important conclusion arising from his work on mammals is the power of the œstrogens to stimulate cells in the ovary to mitotic activity, thus leading at the post-ovulation period to a replenishment of the ovary with a new stock of oogonia. This mitogenic function of the sex hormones would seem to be the field of research now to be explored by Dr. Bullough in his tenure of the Sorby fellowship in the Department of Zoology at Sheffield. He hopes to take up his new work during the summer.

Chair of Medicine at Sheffield: Dr. C. H. Stuart-Harris

As a result of the recommendations of the Interdepartmental Committee on Medical Schools appointed in 1942 under the chairmanship of Sir William Goodenough, Government grants have made possible the establishment of full-time university professorships in medicine, surgery, midwifery and other branches of clinical medicine, and for the proper staffing of the corresponding departments.

At Sheffield, the University, as a first step, has established a full-time chair of medicine, and Dr. C. H. Stuart-Harris has been appointed as the first occupant. Dr. Stuart-Harris was a student at St. Bartholomew's Hospital Medical School, London. After various resident hospital posts he held a number of important clinical research scholarships and fellowships, including a Rockefeller travelling fellowship and later the Foulerton research fellowship of the Royal Society, and he has had important experience in clinical teaching in the Department of Medicine of the British Postgraduate Medical School. Throughout the War he served with the Army Medical Services. He is the author of numerous publications embodying the results of clinical and

laboratory research, both before and during the War, and covering such subjects as rheumatic fever, influenza and typhus.

British Council Office in China: Mr. C. M. G. Bolton

MR. C. M. G. BOLTON has left for China to join the staff of the British Council in Chungking as a geological specialist. Born in Plymouth in 1904, the son of the late Commander A. W. Bolton, R.N., from Berkhamsted School he went to Merton College, Oxford, and graduated in the Honours School of Natural Science in geology. He worked with the Anglo-Iranian Oil Company in Persia, and later was field geologist to the Finsbury Pavement House group of mining companies, working in the Gold Coast area, and was associated with oil-boring in Sussex. In 1940 he joined the R.A.F. and served in Iceland, where he studied the geology, and in 1942 was appointed to the Military Mission in Moscow. In 1944 he was seconded to a military unit to carry out researches on military geology. Mr. Bolton is a fellow of the Geological Society and an associate member of the Institute of Petroleum. As a practising field geologist, he has travelled widely—across Persia from the Persian Gulf to the Caspian Sea and beyond to Moscow, twice across the Sahara from West Africa to Algeria and Morocco, across Africa from West Africa to Kenya, and through the Sudan and the Levant.

Secretary of the American Chemical Society: Mr. A. H. Emery

MR. ALDEN HAYES EMERY has been elected secretary and business manager of the American Chemical Society. Mr. Emery, a former official of the United States Bureau of Mines, succeeds Dr. Charles L. Parsons, who retired on December 31 after serving the Society as secretary for thirty-eight years and as business manager for fourteen. Mr. Emery has been the Society's assistant manager since 1936 and assistant secretary since 1943. Born in Lancaster, N.H., on June 2, 1901, he graduated in 1922 from Oberlin College, where he specialized in chemistry, and obtained his master's degree from Ohio State University in 1923. Mr. Emery then joined the staff of the Bureau of Mines as a chemist at the Pittsburgh Experiment Station. In 1927 he went to Washington to take up administrative work in the Bureau. When he resigned in 1936 to become assistant manager of the American Chemical Society, he was assistant chief engineer of the Bureau's Experiment Stations Division. Mr. Emery was secretary of the American Chemical Society's Division of Gas and Fuel Chemistry during 1933–37, and was assistant editor of *Chemical Abstracts* in charge of its fuel section during 1931–39. He has also edited several sections of *Metallurgical Abstracts* dealing with the chemical aspects of metallurgy. As a member of the American Institute of Mining and Metallurgical Engineers, he helped to establish the Institute's Industrial Minerals Division, of which he was secretary in 1938 and vice-chairman in 1939.

Meteorological Research in Australia

RESEARCH in Australia in the fields of meteorology and atmospheric physics has been receiving active attention recently. Present proposals envisage a subdivision of research between the Meteorological Bureau, the University of Melbourne, and the Council for Scientific and Industrial Research. The Meteorological Bureau is concerned with applied meteorology and climatology for public, economic and defence interests, and is carrying out research on problems connected with its practical functions. During the War it has extended its studies to include intensive investigations in areas to the north of the Australian continent. The School of Meteorology at the University of Melbourne provides theoretical post-graduate training in meteorology, and is undertaking research into problems associated with aeronautical meteorology and other problems of a long-range nature referred to it by the Meteorological Bureau.

It is now proposed that the Council for Scientific and Industrial Research shall establish a Section of Meteorological Physics to concentrate on fundamental research into the physics of the atmosphere. The research work of the three organisations will be co-ordinated by a Meteorological Research Consultative Committee. As a first step, the Council for Scientific and Industrial Research is appointing an officer to take charge of this new phase of its activities, and it hopes to develop in Australia a research laboratory devoted to meteorological physics.

Summer School in Social Biology

THE British Social Hygiene Council is holding a residential summer school in social biology, at Wadham College, Oxford, during August 1–15. The School is being planned to illustrate the scientific approach, through biology, to human life and culture, as well as the ways in which the biological sciences find application in individual and social life. It is designed to appeal to teachers in all types of schools, along with others concerned with education: youth leaders, nurses, welfare workers, people in administrative positions and members of the general public. The main course of lectures will deal with broad aspects of social biology of interest to specialists and laymen alike. The evening lectures will be given by distinguished visiting biologists and social workers, each speaking on work and problems in his own particular field. At the Sunday sessions a special feature will be the discussions on the relation of biological science to ethical and spiritual values.

At the first session each day members will be able to attend either an instructional course in elementary biology, to extend their basic knowledge, or talks and discussions dealing with present-day social and cultural aspects of biology. These alternative courses will be supplemented by tea-time sessions at which speakers will discuss class-room problems of teaching biology and the scope for the biological approach to certain social questions. A series of practical demonstrations, and of visits to scientific institutions, research departments and other places of interest, in and around Oxford, is being arranged. An introductory course in animal dissection will also be offered, if there is sufficient call for it. Social arrangements are also being made. For the whole Summer School, apart from dissections, the inclusive fee will be £14 14*s*. Further details can be obtained from the British Social Hygiene Council, Tavistock House North, London, W.C.1.

Summer School in Health Education

THE Central Council for Health Education will hold one residential summer school in England, this year, at Somerville College, Oxford, during August 14–28 inclusive. The directors of the school will be Miss D. E. M. Gardner, head of the Child Development Department, University of London Institute of Educa-

tion, and Dr. Robert Sutherland, medical adviser and secretary to the Council. The school is intended primarily for those who have to do with the training and care of children and young people—teachers, youth leaders, health visitors, school nurses, educational and medical administrators, training organisers, welfare superintendents, sanitary inspectors and students. The object of the school is to present the general content, methods and practice of health education. Mornings will be devoted to lectures in physiology, psychology, the biology of infection, sociology and health, as well as to lectures, demonstrations and discussions on the various methods and applications of health education. Evening lectures will deal with wider educational, psychological, social, philosophical, and spiritual aspects. There will be opportunity for discussion under experienced leaders, for viewing health films and acquiring technique in visual aids. The afternoons will be left free for optional visits, sports and physical recreation under expert leadership. Local authorities will be asked to consider the possibility of nominating students to attend the school. The inclusive fee will be £14 14*s*. Further details can be obtained from the Medical Adviser and Secretary, the Central Council for Health Education, Tavistock House, Tavistock Square, London, W.C.1.

Root-infecting Fungi

A BRIEF review by S. D. Garrett of recent work upon several root-infecting fungi (*Endeavour*, **4**, 15; July 1945) contains outlines of two new techniques for the prevention of fungal attacks in tropical countries. R. P. N. Napper's method for rubber plantations (which are started with a minimum of jungle clearance in this case) involves half-yearly inspection of the roots of the young trees by trained squads. The mycelium of any root-disease fungus which is found is traced back to its source, usually a jungle root, which is eradicated. Similarly, R. Leach found, in Nyasaland, that the root diseases of plantations arose from fungi developing in moribund roots of jungle stumps. If the jungle trees are ring-barked one year before felling, the roots are entered by saprophytic and not parasitic fungi. Mr. Garrett refers to the beneficial effect of the steam-sterilization of greenhouse soils even when root-infecting fungi are not a danger. He directs attention, also, to the important part such fungi have played in making unprofitable the monoculture of soil-exhausting crops such as wheat in Australia and cotton in the United States.

Old Scientific Books

DURING the last few years Herbert Reichner, of 34 East 62nd Street, New York, 21, has issued a number of catalogues offering for sale early and classic works on all branches of science and philosophy. Nos. 3–6 bear the following titles: Civilization through Five Centuries; French Science and Thought; Great Thinkers from Albertus Magnus to Albert Einstein; Literature, History, Art and Science. These catalogues are well printed, extensively annotated, and indexed; and each of the last three includes a useful list of reference works that have been consulted. Many important and uncommon works are listed, and the catalogues are full of interest for students of the history and early literature of science. They should afford collectors and librarians, if their purses are sufficiently well lined, a number of opportunities to fill gaps in their collections.

Royal Astronomical Society: Officers for 1946

THE following have been elected officers of the Royal Astronomical Society: *President:* Prof. H. H. Plaskett, Savilian professor of astronomy, University of Oxford. *Vice-Presidents:* the Rev. M. Davidson; Dr. H. R. Hulme, scientific adviser to the Air Ministry; Prof. E. A. Milne, Rouse Ball professor of mathematics, University of Oxford; Mr. J. H. Reynolds. *Treasurer:* Sir Harold Spencer Jones, Astronomer Royal. *Secretaries:* Prof. W. H. McCrea, professor of mathematics in the University of London (Royal Holloway College); Mr. D. H. Sadler, superintendent of the Nautical Almanac. *Foreign Secretary:* Prof. F. J. M. Stratton, professor of astrophysics, University of Cambridge. *Council:* Miss M. G. Adam, chief assistant (astronomy), University Observatory, Oxford; Mr. B. C. Browne, lecturer in geodesy, University of Cambridge; Dr. H. A. Brück, John Couch Adams astronomer, University of Cambridge; Mr. D. L. Edwards, director of the Norman Lockyer Observatory, Sidmouth; Dr. M. A. Ellison; Mr. F. J. Hargreaves; Dr. A. Hunter, assistant, Royal Observatory, Greenwich; Dr. E. M. Lindsay, director of the Armagh Observatory; Dr. E. H. Linfoot, lecturer in mathematics, University of Bristol; Mr. P. J. Melotte, assistant, Royal Observatory, Greenwich; Mr. F. J. Sellers; Dr. W. H. Steavenson.

Announcements

RECENT appointments at the University of Sheffield include the following: Dr. Charles Horrex to be lecturer in chemistry; Dr. Eric Hutchinson and Mr. Basil G. Skinner to be assistant lecturers in chemistry; Mr. J. H. Woodhead to be lecturer in metallurgy. The title of emeritus professor has been conferred upon Prof. W. E. S. Turner, who retired from the chair of glass technology on December 31.

DR. T. F. WEST, recently chief chemist to Stafford Allen & Sons, Ltd., is joining the board of the Hygienic Chemical Co., Ltd., as director in charge of scientific research and development.

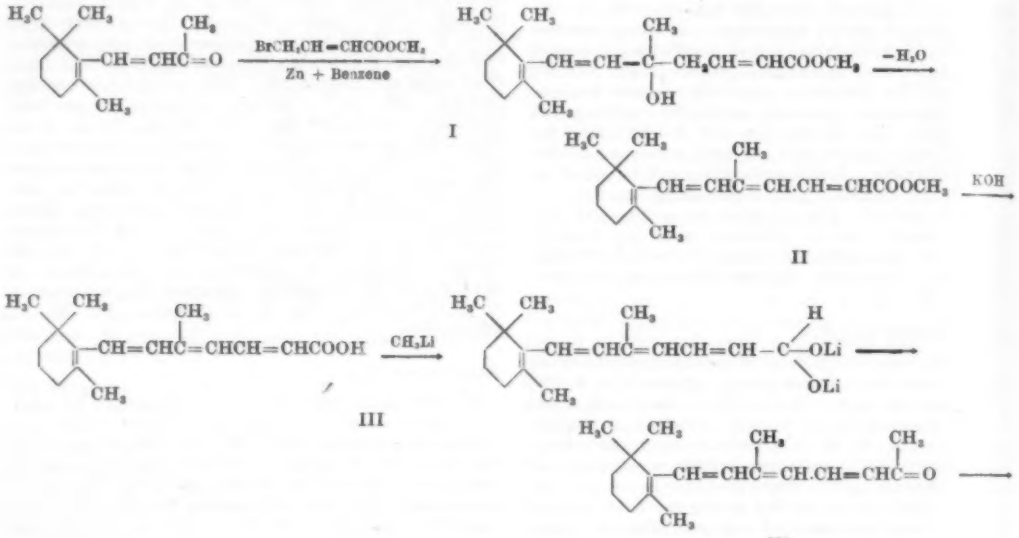
THE following appointments have recently been made by the Colonial Office: J. B. Clegg, to be agricultural officer, Tanganyika; S. Hunter, to be agricultural officer, Nigeria; T. S. Jones, to be agricultural officer, Sierra Leone; A. Lesslie, to be agricultural superintendent, Gold Coast; R. H. Montgomery, to be agricultural officer, Nigeria; R. T. Gray, to be assistant conservator of forests, Nigeria; K. Sargent, to be assistant conservator of forests, Kenya; D. I. Shirlaw, to be assistant conservator of forests, Nigeria; P. T. Preston, to be veterinary officer, Kenya; L. G. Cooper, to be assistant conservator of forests, Nigeria; A. C. Frith, to be assistant conservator of forests, Sierra Leone; J. D. Brown, principal agricultural officer, Nigeria, to be deputy director of agriculture, Nigeria; A. V. Gibberd, agricultural officer, Nigeria, to be senior agricultural officer, Nigeria; A. F. Posnette, botanist, West African Cocoa Research Institute, to be senior specialist, West African Cocoa Research Institute; S. D. Ross, agricultural officer, Nigeria, to be senior agricultural officer, Nigeria; F. S. Collier, deputy chief conservator of forests, Nigeria, to be chief conservator of forests, Nigeria; D. A. Bates, geologist, Gold Coast, to be senior geologist, Gold Coast.

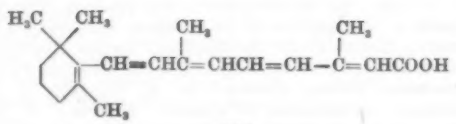
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Synthesis of some Compounds Possessing Vitamin A Activity

We have prepared 'vitamin A acid' (VII) from β-ionone as indicated in the following scheme:

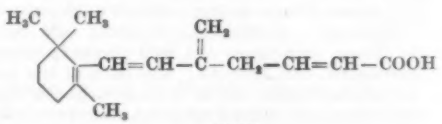




VII

The following are the details of the different stages of this process.

The preparation of ionylidene-crotonic-ester has been described by K. Ziegler in a German patent application. Ziegler assumed that the reaction between β-ionone, γ-bromocrotonic-ester and zinc in benzene produced the ester II, from which by saponification a yellow oily acid was obtained. However, we found that the main product of the reaction mentioned is the *hydroxy*-ester I. By dehydration with anhydrous oxalic acid this ester is partly converted into II. After saponification of the product thus obtained, we isolated three crystalline acids. The main acid is the ionylidene crotonic acid (III). It consists of brittle yellow prisms, m.p. 115·5–157·5° (all melting points have been corrected). The absorption spectrum, which has the same form as that of β-ionone and exhibits a single well-defined maximum at 3200 A. (log $E = 4{\cdot}54$), corresponds exactly to that expected. The two other crystalline acids are colourless. We suppose that the first acid (m.p. 140–141°) is the hydroxy acid I ($COOCH_3{=}COOH$). The second acid (m.p. 161·5–162·5°) is probably formed by splitting off water from I, involving the methyl group of the side-chain. Its structure is probably VIII:



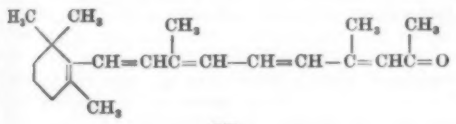
VIII

The conversion of the acid III into the 'C_{18} ketone' IV proceeds very smoothly by means of lithium methyl[1].

A substance to which the same structure is ascribed was prepared by I. M. Heilbron, W. E. Jones, A. Lowe and H. R. Wright[2]. This substance had m.p. 144°, which is uncommonly high for ketones of this type. I. M. Heilbron, W. E. Jones and A. L. Bacharach afterwards stated[3] that the aldehyde, from which this C_{18} ketone was made, had not the structure originally assigned to it; we conclude, therefore, that the C_{18}-ketone also has not the structure originally claimed.

Compound IV is a thick, yellow oil, b.p. 138–140° at 0·01 mm. pressure. The semi-carbazone (m.p. 188·6–189·6°) exhibits a single well-defined absorption maximum at 3470 A. ($\log E = 4·69$). With antimony trichloride in chloroform and also with concentrated sulphuric acid, it produces a deep wine-red colour. It is highly probable that it has a structure very similar to vitamin A, because by means of a Reformatski reaction with bromoacetic ester and zinc in benzene it can be converted into a mixture of the esters V and VI, which has a distinct vitamin A activity. After dehydration of the mixture with anhydrous oxalic acid, followed by saponification, we isolated a yellow crystalline acid VII (m.p. 162–168°), which had a strong vitamin A activity. On further purification the melting point appears to be 181·5° (corr.), and the absorption spectrum max. = 3430 A. log $E_{max.} = 4·65$ (*C*, 0·1 mgm. cal. in abs. ethanol).

The acid VII, for which we propose the name 'vitamin A acid', could be converted into the ketone IX by means of lithium methyl.



IX

This C_{21}-ketone, which is also biologically active, is a yellow oil. The semi-carbazone melts at 189–190°. Unfortunately, we have not yet been able to determine the absorption spectrum of the C_{21}-ketone.

The biological potency (determined by Dr. A. Mennega, Oss, using the growth-test with vitamin A-deficient rats) of the vitamin A acid is dependent on the method of administration. When it is dissolved in pea-nut oil and given orally to rats, its activity is about one tenth that of vitamin A. However, an aqueous solution of the sodium salt, given subcutaneously to rats, is far more potent. The activity is then only half that of vitamin A, given orally; hence it is as active as β-carotene given in oil by mouth.

The C_{21}-ketone IX, dissolved in pea-nut oil and given orally to rats, has an activity of one tenth that of vitamin A, given in the same way.

In the course of these investigations we received valuable assistance from Dr. H. H. Inhoffen, who suggested several other approaches to the problems.

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Oct. 18.

[1] Compare for this method, Gilman, H., and van Ess, P. R., "*J. Amer. Chem. Soc.*, **55**, 1258 (1933).
[2] *J. Chem. Soc.*, 561 (1936).
[3] "Vitamins and Hormones", **2**, 180 (1944).

Direct Synthesis of Hydrazoic Acid

THE reaction between active nitrogen and molecular hydrogen has been the subject of a considerable amount of research. With a glow discharge as the source of active material small yields of ammonia have been reported. Steiner[1], using a condensed discharge, found that hydrazine was produced in addition to ammonia. The direct synthesis of hydrazoic acid has not so far been reported in the literature. In this connexion, it is of interest to record some observations made during recent experiments on the reaction between active nitrogen and hydrogen.

Carefully purified nitrogen and hydrogen were used. The former gave an intense afterglow with a condensed discharge but none with a glow discharge. The experimental set-up was such that only nitrogen (pressure 0·25 mm.) was streamed through the discharge tube and the hydrogen (pressure 0·04 mm.) entered the nitrogen stream at a distance of 20 cm. from the discharge. At a further 2 cm. downstream the gases impinged on a glass surface, which could be cooled to any desired temperature. The gases then passed through a trap cooled in liquid oxygen before entering the pumps. The streaming-rate was about 1,500 c.c./sec. at 0·3 mm. Small yields of ammonia and hydrazoic acid were obtained; the product was a white volatile condensate. Identical experiments with the discharge switched off failed to give any condensable material. Some typical results, with a constant nitrogen pressure of 0·22 mm., are shown below:

Discharge conditions	Surface temp. (° C.)	Hydrogen pressure (mm.)	Ammonia (gm. mole/hr. × 10^8)	Hydrazoic acid (gm. mole/hr. × 10^8)
Condensed, 0·05 mfd.	20	0·030	70	2·7
	−80	0·030	14	4·6
Glow 280 ma. A.C.	0	0·030	18	0·55
	−80	0·017	12	0·28
	−186	0·007	4·2	0·12

The results for ammonia agree with those obtained by other workers. After an acid-alkali separation, both free ammonia and hydrazoic acid were identified by the usual chemical tests. The presence of hydrazoic acid was shown by the colour reaction with ferric ion, and by the reaction with iodine in the presence of carbon disulphide. Both compounds were estimated volumetrically by back titration of excess alkali or acid. The amount of hydrazoic acid was checked by the iodine-carbon disulphide method described by Feigl[2].

The yield was somewhat greater in the case where the condensed discharge was employed, although later experiments showed that it depended on the pretreatment of the electrodes. After prolonged treatment of the electrodes with nitrogen involving the running of the discharge at 280 ma. for more than fifty hours with nitrogen alone streaming through the system, the yields of ammonia and hydrazoic acid fell to 10^{-2} and 10^{-1} of their former values, respectively. Variation of the temperature of the glass surface between −185° C. and +20° C. had no very marked effect upon the yield. This may be due to the relative proximity of the trap cooled in liquid oxygen. As would be expected, the amounts of ammonia and hydrazoic acid formed decreased with decreasing hydrogen pressure.

In agreement with Lewis, Steiner and others, these results suggest that the initial stage in the reaction is the formation of the radical NH within the discharge. The amount of hydrogen diffusing against the gas stream into the discharge zone was calculated and amounted to about 5 per cent of the total. This quantity is sufficient to account for the observed yields of hydrazoic acid and ammonia. The final products are formed by reaction between the radical NH and molecular hydrogen or nitrogen, both processes being in all probability termolecular. The former requires the rupture of an H—H bond and the subsequent formation of two N—H bonds. This process is exothermic to the extent of 64 kcal. The latter entails the direct association of two molecules to form the hydrazoic acid molecule, which possesses a linear nitrogen chain. That the multiplicity rules are obeyed requires a metastable NH to react with a normal nitrogen molecule, or a normal NH radical to react with a metastable nitrogen molecule. When both reactants are in the ground state the reaction is endothermic to the extent of 18 kcal. With either participant in an excited metastable state there is sufficient energy available for the reactions to be exothermic. Both these termolecular reactions are likely to possess considerable collisional efficiencies. The combination of the termolecular nature of the reaction with the small initial concentration of the radical NH is sufficient to account for the relatively small yields of ammonia and hydrazoic acid. The inequality of the amounts of ammonia and hydrazoic acid produced suggests (but does not exclude the possibility entirely) that ammonium azide, N_4H_4, was not formed by polymerization of NH radicals.

The experiments are being continued, more especially with regard to the formation of the imine, NH, radical, and will be published later in greater detail.

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Sept. 18, 1940.

[*Publication deferred for security reasons.*—Editors.]

[1] Steiner, W., *Z. Electrochem.*, **36**, 807 (1930).
[2] Feigl, F., and Chargaff, E., *Z. anal. Chem.*, **74**, 376 (1928).

Ionic Radius of Divalent Copper

In a book recently published by A. F. Wells[1], I have been quoted as the authority for an ionic radius of divalent copper which is given as 1·01 A. (*loc. cit.* pp. 93 and 280). Neither I nor any student of mine has published such an ionic radius for divalent copper. Even a first glance at a modern table of ionic radii shows that such a radius for cupric copper would be most unreasonable, coming as it does between the divalent nickel (0·78 A.) and divalent zinc (0·83 A.). A radius not far from 0·8 A. would be expected (calculated for the 'standard state' of ionic sodium chloride structure), if we could investigate a truly ionic compound of divalent copper, containing non-complex, single, cupric ions, surrounded by such 'hard' anions as fluorine or oxygen, in octahedral or cubic co-ordination.

No such compound has yet been investigated. The closest approach is seen in some spinel structures; for example, the cupric spinels Al_2CuO_4, Fe_2CuO_4, Cr_2CuO_4. A comparison with the analogous magnesium, nickel and ferro-compounds indicates that the radius for cupric ion is not far from 0·8 A., as expected, even if such spinels are by no means wholly ionic compounds.

One might guess that the incorrect radius given by Wells can be traced back to a publication by F. Ebert and H. Woitinek[2] who, in 1933, in an apparatus made of calcium fluoride, produced a substance assumed to be CuF_2, but certainly giving the powder diagram of CaF_2, probably derived from the apparatus; but the one letter, *a* for *u*, made all the difference.

No accurate measurement of the ionic radius of the cupric ion is yet available. Probably the cupric ion, which readily forms planar covalent arrangements, is very far from the ideal of a spherical ion. A more satisfactory determination of the ionic radius of divalent copper will probably be derived from the lattice dimensions of mixed crystals $ZnCO_3$—$CuCO_3$, as represented by the mineral herrerite.

No satisfactory data for the ionic radius of the cuprous ion have been published either. The alleged red powder of CuF, described by Ebert and Woitinek, was probably cuprous oxide. Recently H. v. Wartenberg and F. Laves[3] have found that CuF_2 is monoclinic or triclinic, and that CuF is not stable at ordinary temperature.

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Oct. 24.

[1] Wells, A. F., "Structural Inorganic Chemistry" (Oxford, 1945).
[2] Ebert, F., and Woitinek, H., *Z. anorg. u. allg. Chem.*, **210**, 269 (1933).
[3] v. Wartenberg, H., and Laves, F., *Z. anorg. u. allg. Chem.*, 281, 381 (1939).

I regret having attributed an (incorrect) ionic radius for Cu^{2+} to Prof. Goldschmidt, particularly as the radius always appeared doubtful. The reference is simply a clerical error. Prof. Goldschmidt's letter does, however, raise a point of some importance. While it is true that copper lies between nickel and zinc in the Periodic Table, it is far from true to say that as regards its structural chemistry Cu^{II} lies between Ni^{II} and Zn^{II}. If it exists in any simple solid compound, the Cu^{2+} ion should be found in the oxide or fluoride. The neighbouring divalent elements are

						Mg
Mn	Fe	Co	Ni	Cu		Zn
			Pd			Cd

and the facts about the crystal structures are:

Monoxides: MnO, FeO, CoO, NiO, MgO, CdO, rock-salt structure: ZnO, wurtzite and zinc-blende structures. CuO has a quite different structure, very similar to that of PdO, with square co-ordination of the metal atoms by oxygen.

Difluorides: MnF_2, FeF_2, CoF_2, NiF_2, MgF_2, ZnF_2, rutile structure: CdF_2, fluorite structure. CuF_2 apparently has neither structure; that of PdF_2 is also unknown.

These facts indicate that Cu^{II} does not form simple ionic compounds, and that in preferring square 4-co-ordination, Cu^{II} resembles Pd^{II} rather than Ni^{II} or Zn^{II}. Similarly, copper does not form a 'vitriol' like nickel or zinc, but instead, $CuSO_4.(4+1)H_2O$. In all the compounds $CuCl_2.2H_2O$, $PdCl_2$ and $Zn(NH_3)_2Cl_2$, the distance *M*—Cl is the same ($\sim 2{\cdot}3$ A.); so that if the bonds from the metal atoms are regarded as covalent, the metal atom in

each case acquires a share in six extra electrons. By analogy with Pauling's tetrahedral radius for Zn (1·31 A.) and the square radius for Pd^{II} (1·31 A.), a radius of this value would be assigned to Cu^{II}.

Now in CuF_2, a Cu—F distance of about 2·0 A. is to be expected, and this, like the Cu—Cl distance of 2·3 A., could be accounted for equally well by means of a Cu^{2+} radius of 0·8 A. or a covalent radius of 1·3 A. Either extreme view of such a bond is probably only an approximation. It would seem that Cu^{II} avoids the odd unpaired $3d$ electron by making at least some use of $4s$ and $4p$ orbitals. It may be questioned, therefore, whether much meaning is to be attached to an ionic radius for Cu^{2+}, and in general whether ionic radii should be assigned to any but the most electronegative and the most electropositive elements. The Cu—O bonds in oxy-compounds such as $ZnCO_3$—$CuCO_3$, $Cu_2(OH)AsO_4$, etc., may also have appreciable covalent character, and in the present state of our knowledge it may well be preferable to deal in such cases with interatomic distances rather than 'ionic' or 'covalent' radii. A general discussion of interatomic distances and their analysis in terms of covalent and ionic radii would be very valuable at the present time.

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Spreading of Boundaries in Electrophoresis

The spreading of initially sharp boundaries in the course of the electrophoresis of proteins can be due to three causes: (*a*) thermal diffusion, which ideally gives equal spreading in both limbs, not reversed with reversal of current; (*b*) changes in the potential gradient through the boundary; and (*c*) electrical heterogeneity of the protein.

Cause (*b*) was discussed for a three-ion system by Henry and Britain[1]; they concluded that if one boundary is spread, the other is sharpened, both effects being reversed on reversal of the current. I have tried without success to find whether any set of conditions in such a system can lead to a symmetrical reversible spreading of both boundaries, and I agree with Henry and Britain's conclusion.

Cause (*c*) can be of two types: (1) A complex electrolyte, at a pH in the neighbourhood of the pK's of any of its groups, will be present at any moment in a number of ionic forms of different mobility, the rate of interchange between them being large compared with the rate of transport. If one of these forms i is a fraction a_i of the whole, and has velocity u_i, the mean rate of transport[2] is:

$$u_m = \Sigma(a_i u_i).$$

By considering the transport of electrolyte across a plane, if Δt_i is the mean life of the form i, it can be shown that

$$\frac{\partial c}{\partial t} = \tfrac{1}{2}\Sigma a_i(u_i - u_m)^2 \Delta t_i \cdot \frac{\partial^2 c}{\partial x^2}.$$

This shows that if the quantities a_i, u_i, u_m, Δt_i are constant throughout the boundary, a spreading occurs due to the dispersion of velocities of the different ionic forms, which is formally equivalent to diffusion except that it increases as the square of the potential gradient. It is not reversible with the reversal of current. Δt_i is likely to be of the order of 10^{-14} sec.: the spreading due to this cause is therefore likely to be small compared with that due to diffusion.

(2) The protein may be a mixture of forms, not interconvertible, having different mobilities. This will lead to a reversible spreading, equal in both limbs; the form of the spread boundary will depend on the distribution of the concentrations and mobilities of the component forms[5].

Sharp *et al.*[3,4,5] have observed a reversible and symmetrical spreading of the boundaries of rabbit papilloma virus and horse pseudoglobulin; they ascribe this to electrical heterogeneity. It is clear that in the light of present knowledge this must mean heterogeneity of the second type: that is, that such a preparation consists of a range of different substances.

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[1] Henry, D. C., and Britain, J., *Trans. Faraday Soc.*, **29**, 798 (1933).
[2] Tiselius, A., *Nova Acta Reg. Soc. Sci. Upsaliensis*, IV, **7**, 1 (1930).
[3] Sharp, D. G., Taylor, A. R., Beard, D., and Beard, J. W., *J. Biol. Chem.*, **142**, 193 (1942).
[4] Sharp, D. G., Cooper, G. R., and Neurath, H., *J. Biol. Chem.*, **142**, 203 (1942).
[5] Sharp, D. G., Hebb, M. H., Taylor, A. R., and Beard, J. W., *J. Biol. Chem.*, **142**, 217 (1942).

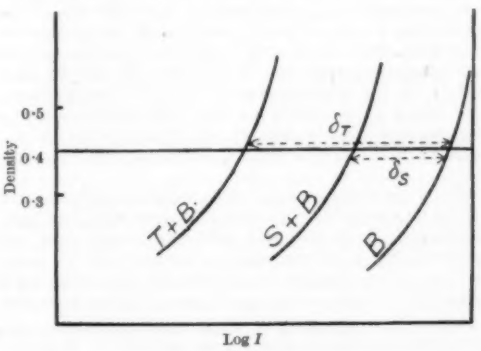
Background Correction in Spectrographic Analysis

In quantitative spectrographic analysis, values are frequently obtained for the logarithms of the intensities of spectral lines which are superimposed on backgrounds which cannot be disregarded. The calculation of the logarithm of the intensity of the line itself, freed from the effect of background, is somewhat tedious even if subtraction logarithms be employed[1]. In most quantitative methods, an internal standard technique is used, the object being to obtain $\log(I_T/I_S)$, from $\log(I_T+I_B)$, $\log(I_S+I_B)$ and $\log I_B$, where I_T is the intensity of the trace element or analysis line, I_S that of the internal standard and I_B that of the background.

In the use of subtraction logarithms, if $\log(I_T+I_B) - \log I_B = \delta_T$ and the subtraction logarithm of δ_T is γ_T, then $\log I_T = \log(I_T+I_B) - \gamma_T$. Similarly, $\log I_S = \log(I_S+I_B) - \gamma_S$.

It is desired to direct attention to the simplification of the calculation of $\log(I_T/I_S)$ by the use of a table giving values of $(\delta - \gamma)$ for values of δ. From the above,

$$\log I_T = \log(I_T+I_B) - \gamma_T = (\delta-\gamma)_T + \log I_B,$$
$$\log I_S = (\delta-\gamma)_S + \log I_B;$$
$$\therefore \log(I_T/I_S) = (\delta-\gamma)_T - (\delta-\gamma)_S.$$



where the background is the same for both lines. The table actually gives values of log n for values of log $(n + 1)$ as, from the above, $(\delta - \gamma)_T = \log I_T/I_B$ and $\delta_T = \log (I_T + I_B)/I_B = \log (I_T/I_B + 1)$.

If relative intensity values are obtained at a constant density from blackening curves[2], as in the accompanying diagram, then δ_T and δ_S can be read off directly as shown, $(\delta - \gamma)_T$ and $(\delta - \gamma)_S$ obtained from the table, whence log (I_T/I_S) follows by simple subtraction. If the lines are on backgrounds of differing intensity, the separations to the respective background curves are read, and to the difference of the $(\delta - \gamma)$ values is added the separation between the backgrounds, this being positive when the background of the trace element line is the stronger.

Where log $(I_T + I_B)$, log $(I_S + I_B)$ and log I_B are obtained by single-value measurements, the δ values can be found by subtraction, otherwise the calculation follows the same lines. The table is thus of general application for the calculation of log a/b knowing log $(a + x)$, log $(b + x)$ and log x.

A suitable three-figure table of $(\delta - \gamma)$ for values of δ, where γ is the subtraction logarithm of δ, of adequate accuracy for spectrographic analysis, has appeared in the Macaulay Institute Annual Report (1943–44) and offprints are available.

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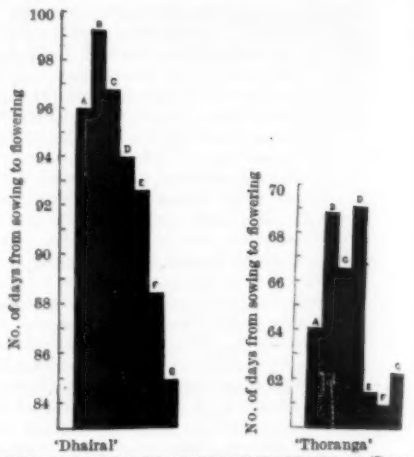
[1] Macaulay Institute Annual Report 1942–43.
[2] Scott, R. O., *J. Soc. Chem. Ind.*, **63**, 4 (1944).

Vernalization of Rice

In certain parts of Bengal considerable rice crop of 'aus' paddy* is damaged, due to the incidence of early flood (July and August) submerging the whole crop when it is about to ripen. So it was considered that 'aus' plants might be made to escape the flood by reducing their life-period by the technique of vernalization. It must be mentioned that among the numerous varieties of 'aus' paddy there is no variety the life-period of which is less than ninety days, and these are usually low yielding. Hence an approach to the problem was made by reducing the life-period to less than ninety days of the existing high-yielding strains by vernalization.

Hedayetullah and Sen[1] working on vernalization of 'aus' paddy have reported that this paddy responds to the treatment of vernalization, and the beneficial effects have been observed at higher temperatures. Flowering was significantly earlier than the control by vernalizing seeds at 29·5° C. for 15 and 10 days and 11° C. for 15 days, the acceleration being 12·06, 7·43 and 4·71 days respectively. The yield of grains was reduced at 0° C. and 11° C., while at 29·5° C. for both 15 and 10 days yield tended towards improvement.

The work was repeated with different temperatures —5°, 15° and 35° C. for 15 and 25 days with two 'aus' varieties, 'Thoranga' and 'Dhairal', early and late respectively, together with a control set for each variety in an attempt to account for the earliness of flowering of 'aus' varieties of rice at higher temperatures. Here the induced earliness of flowering has been observed at 35° C. for 15 and 25 days, the acceleration being 7·5 and 11·2 days respectively in 'Dhairal', while in 'Thoranga' no appreciable response has been obtained to any treatment of vernalization, as shown in the accompanying figure. It seems that vernalization has had very little effect on the early 'aus' variety. Flowering is retarded in both the varieties of rice at 5° C. for 15 and 25 days and at 15° C. for 15 days. In 'Dhairal', yield of grains per plant at 35° C. for 15 and 25 days shows some improvement. So far, the experiment was conducted in pots. This year the vernalized seeds of 'aus' paddy are being tested on a randomized field scale against control (non-vernalized) seeds.



Histograms showing the range of flowering of 'Dhairal' and 'Thoranga'. Flowering is most early in *G* in 'Dhairal', but there is no appreciable response to higher temperatures in 'Thoranga'. Flowering is retarded in both varieties at low temperature.

A, control; *B*, 5° C., 15 days; *C*, 5° C., 25 days; *D*, 15° C., 15 days; *E*, 15° C., 25 days; *F*, 35° C., 15 days; *G*, 35° C., 25 days.

Full details of the experiments will be published elsewhere.

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[1] Hedayetullah, S., and Sen, N. K., *Sci. and Culture*, **6**, No. 11 (1941).

Secretion of Pepsin in Achlorhydric Human Subjects after Injection of Histamine

Babkin[1] found in the gastric juice of dogs formed after the parenteral administration of histamine high acidity but little or no pepsin. Similarly, the histological preparations of Bowie and Vinberg[2] showed the peptic cells affected after vagus stimulation but not after histamine. The findings in man are more contradictory. Bloomfield[3] and Polland[4] reported high concentration of pepsin in human stomach juice after histamine injection, but their data were not confirmed by Toby. Indeed it has been suggested that in the positive experiments enzyme which was secreted prior to the histamine injection was washed from the lumen of the tubules by the acid coming from the parietal (acid) cells[5].

* 'Aus' paddy is the summer paddy sown broadcast on the highlands in April–May and harvested in August–September.

We have attempted to decide this question by injecting histamine into achlorhydric and—as far as stomach hydrochloric acid was concerned—histamine refractory patients and by measuring the pepsin concentration in the stomach juice before and 30 min. after injection. If an increase of pepsin was found in the second sample, this could not have been caused by a 'flushing effect' of acid from the parietal cells.

The subjects used in our investigations were Indian soldiers showing post-dysenteric achlorhydria refractory to histamine. Stomach juice was taken from the empty stomach by means of a Ryle tube before and 30 min. after an intramuscular injection of 0·75 mgm. of histamine hydrochloride. Mucus was removed by centrifuging and the supernatant was used for estimations. Total acids were determined by titrating against 0·1 *N* sodium hydroxide using phenol phthaleine as indicator. Results were expressed as ml. 0·1 *N* hydrochloric acid per cent. Pepsin was estimated as *pe* $\frac{T°}{t'}$, by measuring the digestion of edestin using Fuld's method as given by Cole[6]. When *pe* $\frac{T°}{t'}$ was found to be <1 the result was noted as nil.

ESTIMATIONS ON THE STOMACH JUICE OF TWELVE INDIAN SOLDIERS SUFFERING FROM HISTAMINE REFRACTORY ACHLORHYDRIA. PEPSIN AND TOTAL ACIDS BEFORE AND 30 MIN. AFTER INJECTION OF 0·75 MGM. HISTAMINE HYDROCHLORIDE.

Case	Date 1945	$T°$ as degree C.	Pepsin as *pe* $\frac{T°}{30'}$		Total acids as ml. 0·1 *N* HCl %	
			before histamine	after histamine	before histamine	after histamine
I	19·1	11·4	Nil	2	8·0	6·0
II	21·1	15·2	Nil	2	12·0	9·0
III	10·3	16·2	16	8	10·0	16·0
IV	13·3	19·5	Nil	8	5·4	6·0
V	19·3	19·6	Nil	64	8·6	18·4
VI	29·3	19·3	2	2	8·8	20·0
VII	2·4	19·3	8	64	9·6	23·8
VIII	16·4	22·4	Nil	64	8·4	20·8
IX	30·4	27·5	2	Nil	3·0	8·0
X	12·5	29·2	Nil	Nil	6·2	7·0
XI	7·6	32·5	Nil	32	9·0	13·0
XII	9·7	33·1	32	64	5·4	10·2

The accompanying table shows the concentration of pepsin and of total acids found in the stomach juice before and 30 min. after histamine injection. The value for t' in *pe* $\frac{T°}{t'}$ was always 30 min. $T°$ varied and is given for each experiment. As stomach function is supposed to undergo seasonal variation the date for each experiment is given.

To calculate the average result, nil was reckoned to be zero; *pe* $\frac{22·5° \pm 7·5 \text{ (S.E. mean of 12 observations)}}{30'}$ was 5 ± 8 (12) before and 25 ± 27 (12) after histamine injection. This five-fold average rise is of above 95 per cent probable significance.

We found pepsin production frequently to be deficient in the post-dysenteric state, regardless of whether the patients were achlorhydric, hypo- or normal-chlorhydric. In 50 per cent of these cases little or no pepsin rise was seen by us after a meal of oatmeal gruel when stomach juice samples were investigated at intervals throughout 2 hr. It is thus not surprising that in the present investigation in seven out of twelve cases practically no pepsin was found initially. Six of these showed an increase of pepsin. In five cases a certain amount of pepsin was present at the beginning; its concentration rose in two, it remained constant in one and fell in two of these cases. Obviously in these latter the increase in stomach juice as indicated by the rise of total acids was not accompanied by sufficient pepsin production and led to a dilution of the enzyme which was present initially. In case VI, where the pepsin concentration remained constant, the total acids increased almost two and a half times, so that there must have been in fact a steady production of pepsin to keep up the original concentration. In all, at least nine out of twelve cases showed a production of pepsin after histamine injection.

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Menarche, Growth and Physical Efficiency

THIS is a summary of an analysis of anthropometric measurements and functional performances of a socially homogeneous sample of 40 white South African schoolgirls of thirteen years of age. Of these, 20 were in the pre-menarcheal state (group *M*−), while the other 20 had started to menstruate (group *M*+). Student's *t*-test was used to determine significance of differences (see accompanying table).

The girls in group *M*+ were taller, heavier and more bulky for their height than were those in group *M*−. The differences are equivalent to about one and a half years of cross-sectional growth at the age period under review as evaluation on our South African standard grids reveals[1,2]. Although it is not as marked as in the case of weight, the correlation between menarche and height is noteworthy: even the powerful developmental stimulus of physical training does not appreciably affect growth in length[3]. In respect of all the other body measurements referred to in the accompanying table, we found a superiority of group *M*+ over group *M*−. An interesting point revealed by testing the ratio between upper arm circumference and body weight is that proportionately muscular development of the upper extremities was more marked in group *M*− than in group *M*+, notwithstanding the fact that arm circumferences of the latter were greater than those of the former.

Such differences as were found between the physical performances of the girls of the two groups were not large enough to satisfy the strict requirements of the small sample test to declare them significant. There was, however, a distinct and consistent trend of the *M*+ group to surpass the *M*− group in the shot-put and in the other performances demanding strength, while the opposite holds good for the 600

BODY MEASUREMENTS AND PHYSICAL PERFORMANCES OF TWO GROUPS OF GIRLS 13 YEARS OLD.

Number	M+ 20 Mean	M+ 20 Range	M− 20 Mean	M− 20 Range	Significance of differences according to Student's *t*-test. Probability level 0·01	0·05	0·1
	yr. m. dy.	yr. m. — yr. m.	yr. m. dy.	yr. m. — yr. m.			
Age	13 1 27	12 2 — 13 8	13 0 27	12 5 — 13 10	0	0	0
Height (in in.)	61·04	56·0 — 63·4	59·58	55·0 — 63·6	0	+	+
Weight (in lb.)	108·7	81·3 — 156·9	87·4	72·0 — 107·9	+	+	+
Chest circumference (in in.):							
Inspiration	32·5	28·5 — 37·5	30·4	28·3 — 33·5	+	+	+
Expiration	30·3	27·5 — 35·0	28·3	26·0 — 32·2	+	+	+
Abdominal circumference (in in.)	26·0	22·5 — 31·8	23·8	21·5 — 28·2	+	+	+
Upper arm circumference (in in.):							
Relaxed	9·1	7·8 — 10·4	8·3	7·1 — 9·6	+	+	+
Tense	9·7	8·0 — 11·8	8·8	7·1 — 10·4	+	+	+
Ratio = $\frac{\text{Upper arm circumference (in in.)}}{\text{Body weight (in lb.)}} \times 100$	8·762	7·073 — 10·118	9·834	8·384 — 11·458	+	+	+
Leg circumference (in in.):							
Calf	12·8	11·1 — 14·4	11·7	10·4 — 12·9	+	+	+
Thigh	18·9	16·2 — 22·9	16·8	15·0 — 18·8	+	+	+
Hand Pressure Dynamometer (Collins):							
Right Hand	122·9	70·0 — 192·0	118·7	100·0 — 140·0	0	0	0
Left Hand	97·7	40·0 — 170·0	87·0	28·0 — 140·0	0	0	0
100 yards running (in sec.)	15·9	13·8 — 19·3	16·0	13·9 — 20·0	0	0	0
600 yards running (in sec.)	172·3	139·6 — 225·0	160·9	135·0 — 200·0	0	0	0
Shotput (12 lb.) (in in.)	122·3	69·0 — 170·0	110·1	73·0 — 154·0	0	0	+

yards running race. For the 100 yards sprint, no differences of any kind were noted. The foregoing findings correlate well with the standard grids of physical efficiency as presented by Jokl and de Jongh in 1943 [4]. At puberty girls become stronger, their endurance deteriorates, while their sprinting performances remain virtually unchanged. In a variety of studies of physical development and muscular efficiency of girls, sexual maturation was found to cause incisive changes of progress patterns of growth or even a distinct reversal of trends, for example, in regard to physical endurance[5]. In 1937 Shuttleworth[6] demonstrated that menarche rather than chronological age marks the onset of the above alterations of rate or direction of growth. Thus, the study of correlations between menarche and growth is of special interest to physical education, since it links up a well-analysed field of applied physiology with an important chapter of experimental and clinical endocrinology.

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Authenticity of Scientific Anecdotes

IN the "Mémoires" of the Baron de Grimm[1], describing the ascent on June 27, 1783, from the Champ de Mars at Paris of the first balloon (*globe aérostatique*) in the presence of an enthusiastic crowd of spectators, he says: "Beaucoup de gens qui se piquent de rester froids au milieu de l'enthousiasme public, n'ont pas manqué de répéter: Mais quelle utilité retirera-t-on de ces expériences? A quoi bon cette découverte dont on fait tant de bruit? Le vénérable Franklin" (who was presumably in Paris at the time) "répond avec sa simplicité accoutumée: Eh! à quoi bon l'enfant qui vient de naître?" On my directing the attention of Sir Henry Tizard to this passage, he told me that the *not* here attributed to Franklin is generally quoted as Faraday's. It is so, for example, in Sir Richard Gregory's "Discovery" (1916), p. 3, where we are told (the authority is not given) that, after an experiment performed by Faraday at one of his Royal Institution lectures, a lady asked: "But, Professor Faraday, even if the effect you explained was obtained, what is the use of it?" The memorable reply was: 'Madam, will you tell me the use of a newborn child?'" If the story be true, Faraday was no doubt, whether or not aware at the moment of its source, remembering the saying of Franklin reported by Grimm. I see that in a note to the latest edition (1937) of Bartlett's "Familiar Quotations", the credit is given to Franklin, on the authority of James Parton in his "Life and Times of Benjamin Franklin", whose statement, it is added, was taken from Grimm's "Mémoires".

It is amusing to find that Grimm, though recording Franklin's sagacious observation, himself pokes fun at the extravagant anticipations of 'coffee-house politicians' who calculated "avec un douleur vraiment patriotique l'accroissement de dépenser que causerait sans doute l'établissement indispensable d'une marine aérienne", and the fears of 'M. Gudin de la Brenellerie' that "l'Angleterre notre rivale ne s'en empare, ne la perfectionne avant nous, et n'usurpe bientôt l'empire des airs, comme elle usurpa trop longtemps celui de Neptune". Without the excuse of a real invention like Montgolfier's, the poet Gray, nearly half a century earlier, in a Latin prize poem written when an undergraduate of Pembroke College, Cambridge, had indulged on behalf of his country a similar dream.

Anglia, quae pelagi jamdudum torquet habenas,
Exercet que frequens ventos, atque imperat undae;
Aëris attollet fasces, veteresque triumphos
Hùc etiam feret, et victis dominabitur auris.
—(*Luna Habitabilis*, 1737.)

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THERE are two famous anecdotes told concerning Michael Faraday and the usefulness of scientific discoveries. They appear in various forms in the works

of the nineteenth- and twentieth-century writers on scientific subjects. Both are told usually in relation to Faraday's discoveries in the field of electromagnetism. The usual form of the stories is that some dignitary or public official, usually the Prime Minister himself, visited Faraday at the Royal Institution and, on being given a demonstration of the phenomenon of induced currents, inquired: "What good is it?" One of the stories has it that Faraday replied: "What good is a new-born baby?" The other has it that he replied: "Soon you will be able to tax it"[1].

The first answer is also attributed to one of Faraday's predecessors in electrical discovery, Benjamin Franklin. This answer expresses in such felicitous terms the feelings of all men of science who have made discoveries that it has seemed worth while to bring to light the true circumstances in which it was used both by Franklin and by Faraday.

In 1783 Benjamin Franklin was in Paris as minister plenipotentiary for the American Colonies, and witnessed the various balloon ascents that were made for the first time in that year. More than an interested spectator, Franklin wrote several accounts of these ascents, which he sent to his good friend, Sir Joseph Banks, president of the Royal Society[2]. In a letter of August 30, he wrote to Banks: "The Multitude separated, all well satisfied & much delighted with the Success of the Experiment, and amusing one another with Discourses of the various Uses it may possibly be apply'd to, among which were many very extravagant. But possibly it may pave the Way to some Discoveries in Natural Philosophy of which at present we have no conception."[3] But some of those present queried what use it might have, and to these Franklin replied with the famous statement: "What good is a new-born baby?" Mr. Carl Van Doren, in his splendid biography of Franklin[4], points out that the image rose naturally to his mind, since there was a baby in his own house at Passy at the time, little two-weeks old Ann Jay, daughter of John Jay.

Baron Grimm hastened to send this gem of Franklinian wit to his various correspondents in Germany, Poland and Russia, "Eh! à quoi bon l'enfant qui vient de naître?"[5] In the Franklin papers in the library of the University of Pennsylvania there is a letter addressed to Franklin in which the author is "incensed at Dr. Franklin daring to call his balloon an infant just coming to birth"[6].

Michael Faraday used Franklin's apothegm in 1816 in a lecture before the City Philosophical Society, where his subject was: "On Oxygen, Chlorine, Iodine and Fluorine". This lecture reads in part: "Before leaving this substance, chlorine, I will point out its history, as an answer to those who are in the habit of saying to every new fact, 'What is its use?' Dr. Franklin says to such, 'What is the use of an infant?' The answer of the experimentalist would be, 'Endeavour to make it useful'. When Scheele discovered this substance it appeared to have no use, it was in its infantine and useless state; but having grown up to maturity, witness its powers, and see what endeavours to make it useful have done."[7]

Faraday was interested in chlorine since his master, Sir Humphry Davy, had shown in 1810 that the oxymuriatic acid which had been obtained by Scheele was an element and not a compound; Davy named it chlorine[8]. In the same year, working under Davy's supervision, Faraday succeeded in liquefying chlorine. The use to which Faraday referred was evidently in the manufacture of bleaching powder by the method introduced by Charles Tennant of Glasgow in 1798, which had developed into a large and prosperous industry.

The second anecdote, that of saying to the Prime Minister: "Soon you will be able to tax it", presents a different story. I have been unable to find it authenticated in any major biography of Faraday. It seems an unlikely story. The only application of his research that he witnessed in his own life-time was in the "magneto-electric light" for lighthouse purposes. The vast practical industry that has been reared upon his fundamental discoveries was still to be born. He declared in 1831, "I have rather been desirous of discovering new facts and new relations dependent on magneto-electric induction, than of exalting the force of those already obtained; being assured that the latter would find their full development hereafter."[9]

One cannot prove, of course, that Faraday did not make this statement. But, until we have evidence that he did so, as we have in the case of the statement about the infant, this anecdote must be labelled 'doubtful'. Historical research discloses the truth of anecdotes which were considered to be in the 'doubtful' category for many centuries. The most famous of these is the story of Isaac Newton and the apple, classified for a long time as being even absurd. Yet this story, as Jean Pelseneer pointed out[10], to-day finds corroboration. It is given in full in a biography of Newton written by his friend and admirer, the renowned antiquary, the Rev. William Stukeley (1687–1765). This biography remained unpublished from 1752, when it was completed, until 1936, when it was first published. Newton, Stukeley wrote, and he were drinking tea under the shade of some apple trees, and Newton told him that "he was just in the same situation, as when formerly, the notion of gravitation came into his mind. It was occasion'd by the fall of an apple, as he sat in a contemplative mood. . . . This was the birth of those amazing discoverys, whereby he built philosophy on a solid foundation, to the astonishment of all Europe."[11]

If a story believed for so many years to be an absurd fiction can at last be authenticated as this one has been, then surely it is possible that the story of Faraday and the Prime Minister may some day be shown to be a true one. But, until that time, we had better doubt it and not repeat it as a true happening in Faraday's career.

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No personal references are necessary; every year one or both of these anecdotes appears in books and articles.

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FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

VICTORY CONGRESS

AFTER July 1939, when it held a great congress in Liège, the activities of the French Association for the Advancement of Science slackened and passed, so to say, into suspense. But with France liberated and victorious, it was decided without delay to revive its normal activities. During October 20–26, 1945, its sixty-fourth meeting, the Victory Congress, was held in Paris under the presidency of M. Piéron, professor at the Collège de France. By arranging this Congress, the French Association wished to show that, throughout the period when means of expression were so cruelly denied to France, right up to the present time, when difficulties still exist, the flame of French science has never been extinguished, in spite of all the efforts of the forces of occupation during the years of oppression. The Association called upon workers in every branch of science to take note of this occasion, and invited men of science of the Allied nations to renew the co-operation, formerly so productive. The countries represented included Great Britain, the United States, the U.S.S.R., Switzerland, Argentina, Canada, the Netherlands, Sweden, Norway, Czechoslovakia, Belgium and Poland. Representatives from Roumania and Denmark were prevented from attending by transport difficulties.

The inaugural session of the Congress was held in the grand amphitheatre of the Sorbonne. M. Le Troquer, president of the Municipal Council of Paris, welcomed the members of the Congress, and particularly the foreign delegates, whose representatives then read or deposited addresses to the Association. Prof. Frédéric Joliot-Curie, of the Collège de France, and director of the Centre National de la Recherche Scientifique, set forth the problems of scientific research in France, showing what has been done already to co-ordinate scientific work, to help research workers, and to organise research. He also indicated what remains to be done in order that research in France may take the place which belongs to it and which it should occupy in the life of the nation. Prof. Justin Besançon, of the Faculty of Medicine and president of the French Red Cross, dealt with malnutrition during the war period. The War and the German occupation in the countries overrun by the Nazis provided a real and deplorable biological demonstration by creating a state of famine. The manifestations of this state were various—emaciation, œdema due to want, osteopathic affections and symptoms due to lack of vitamins. The means available to combat these conditions were always imperfect and there has been a terrible recrudescence of tuberculosis.

Finally, M. Piéron, president of the Association, explained the motives which had actuated the Association in holding the Congress, and thanked the delegates of the Allied and friendly countries for attending the Congress in such numbers despite all difficulties. He then gave a discourse on time from the point of view of psychology. In biology, the dominating characteristic of time is irreversibility, which physicists can often neglect in their equations, and there is a close affinity between time and life. The action of time, too often neglected, is fundamental in the processes of sensory activity, where quantities are in question which show progressive and regressive evolution of the observed intensities. Variations of duration may manifest themselves in spatial form, and conversely, variations in space may assume an aspect of time: certain examples were given. At a level below perception, differences of the order of a hundred-thousandth of a second are effective, while the perceptive discrimination of time is a thousand times less acute.

Psychological time, despite the illusion of continuity, he pointed out, is made up of 'instants' which represent, as it were, atoms of time, in the direct appreciation of durations limited within a range of some seconds. Beyond this range, indirect perceptions rest upon physiological periodicities, modelled in general upon physical or social rhythms, with notable affective influences. For periods of some hours, appreciations of time are intellectual and are based upon a wealth of experience, which entails the apparent acceleration of the passage of time as age increases. Subjective time, considered as true time in Bergsonian philosophy, is not grasped by purely immaterial intuition, for it is governed, as with the animals, by the law of acceleration with temperature which applies to the chemical substratum of neurobiological processes.

There is in reality no such thing as 'true time', Prof. Piéron said; the idea of time dissociated by abstraction from the only 'reality', that of phenomena, is acquired with difficulty by the child under the influence of a social system of education, and the dimension 'time' of the physicists, an abstraction which diverges in a striking way from ordinary ideas, reaches a profound truth to which the success of scientific predictions bears witness.

On the morning of October 21, a series of visits was arranged: to the Pasteur Institute, the Palais de la Découverte, the Musée de l'Homme, the Zoological Park at Vincennes, and the Musée du Louvre.

On October 22, the work of the Congress began. Mornings were devoted to sectional conferences, the afternoons to joint meetings of several sections to hear communications on border-line subjects not within the purview (often too limited) of the sections. At the end of the afternoon sessions there were general discussions of wide compass addressed to the whole body of the Congress.

The essential aim of the statements presented was to provide a balance sheet of work done in each department of science by French research workers during the years of the enemy occupation, 1940–45.

General discourses were given by: M. Jeannel, professor in the National Museum of Natural History; M. Boivin, head of the Pasteur Institute; M. Lacassagne, director of the Radium Institute; and M. Rocard, of the Faculty of Sciences, Paris.

Prof. Jeannel discussed cave-life, a subject on which he is an outstanding authority.

M. Boivin dealt with the astonishing variability of microbes and its significance from the point of view of general biology. Bacterial cells, regarded from the combined morphological and physiological aspect, possess great plasticity. The reversible and irreversible transformations which bacteria are capable of undergoing under various influences are of great importance in the framework of the notion of species. The consideration of antigenic structure and of the body of constituent enzymes led to the discussion of recent American work and of results obtained by M. Boivin himself, showing that an active principle of a nuclear character may be ex-

hibited by each bacterium, capable in its turn of inducing the appearance, in other bacteria, of the antigenic type and enzyme equipment of the primary bacterium. Viruses also present wide variability of pathogenic power.

M. Lacassagne spoke on radiology in France during 1940–45. He paid tribute to the memory of French radio-biologists who died in German prisons or concentration camps: Holweck, Wollman and Mme. Wollman, Vles, Reiss, Florence, Crolan and Segal. The work accomplished by these workers and their colleagues falls under four headings: quantum radiobiology, the role of oxygen in the production of radio-lesions, the relations between radiations and cancer, and finally the biological use of artificial radio-elements, and in particular the fixation of radioactive iodine in the thyroid.

The phenomena of self-oscillation formed the subject of the address by Prof. Rocard, who presented an account of the progress made in France during recent years towards the understanding of these conditions. Whereas formerly the workers in this field were content to discuss in a formal way the stability of solutions of the differential equation governing an oscillatory phenomenon, we have now succeeded in classifying the causes of self-oscillation. It is well known that in a system with one degree of freedom the cause of self-oscillation is the introduction of a negative resistance. In the case of many degrees of freedom, it has been recognized that, while a negative resistance always constitutes a possible cause, self-oscillation is caused even in the absence of any positive or negative resistance by the approach of two proper frequencies which merge when certain parameters vary. Luckily, it can be shown that in every passive system (masses and springs, or self-inductions and capacities, etc.) coupling always separates the proper frequencies; but if we introduce relays, relations which are not holonomic, forces which do not depend on a potential, we find that the possibility of self-oscillation is created by this mechanism, even if these forms are always in quadrature with the velocities. Furthermore, the following very important theorem has been demonstrated: if in such a system we add, in an endeavour to damp it, resistances or frictions, we only make self-oscillation easier, in any event so long as these resistances do not modify too much the proper frequencies. Applications of this work have been made to the vibration of the wings of aeroplanes, to the sway of locomotives, to various phenomena of rolling and so on.

Among inter-sectional addresses, reference should be made to those on electro-encephalography (A. Baudouin, Fessard, Titeca), on typology (Delaporte), on the application of the calculation of probabilities in biology, on Mendelian biology and mathematics (Malicot).

Special reference must be made to the address on the destruction and reconstruction of the great French ports (M. Boucher), and on war damage in France and the problems of reconstruction which lie ahead (M. Sasportes).

The closing session took place on October 26 in the grand amphitheatre of the Faculty of Medicine, Paris. M. Cholley, dean of the Faculty of Letters, gave an address on agrarian systems and rural settlement. The relationship between any agrarian system and the form of settlement associated with it is well recognized, as also are the exceptions to such relationship. This relationship, however, is not intelligible unless these two phenomena are considered as a true biological and anthropological synthesis which, like all biological syntheses, conforms sometimes to strict laws determined by its structure or by the influences of physical and biological environment; and sometimes, like all manifestations of life and particularly of human activity, is liable abruptly to break the cycle or rhythm which it has followed down to a given moment, to diverge in another direction.

The elements which compose the actual structure of the syntheses are, M. Cholley said, four in number: the distribution of population, to be viewed according to density but more particularly according to social structure; cultivation system (plan, rotation, etc.); the soil and its composition; settlement. Between these elements there exists so close a relationship that if one of them varies the others are altered; for example, the introduction of a new crop in Brie, sugar-beet, caused modifications, in the nineteenth century, of the rotation of crops which had repercussions on the agrarian system, then on the social structure, and even on the demographic conditions of settlement. Examples might also be cited showing the effects, on the structure of the synthesis, of modifications in demographic values or in the social organisation of the distribution of population.

Like all biological and anthropological syntheses, agrarian syntheses reveal themselves in phenomena of spatial extent; once organised, they tend to gain ground as plant-groups do (for example, the Lorraine and Beauceron systems). They reveal, moreover, a real dynamic force which can be measured not only by the value of products but also more effectively by the coefficient of population and by the standard of living determined by that of productivity. The synthesis, moreover, is in a state of constant evolution, which may develop regularly, or in a cycle, with stages of youth, maturity, and old age from the point of view of demography and of labour; but it may also exhibit 'misfires' or abrupt changes of condition marked by serious crises.

Lastly, like all biological syntheses, our agrarian syntheses adapt themselves to natural conditions, in a sense difficult to define except with a full knowledge of those conditions—climate, soil, biological factors—to which such syntheses conform. Examples might even be cited of syntheses which appear to have achieved a positive paradox in relation to natural conditions.

The purely historical method which hitherto has guided our researches, and in all countries has yielded noteworthy results, is therefore insufficient. The study of the problems of agrarian systems should be inspired by biological method, which consists of collecting observations of all recognizable types of agrarian syntheses in every part of the world, while seeking to understand their structure and changes in such a way as to distinguish the conditions which determine them. It should be added that inquiry on these lines in 'new' countries is a matter of urgency, especially where the unifying process of colonization so quickly effaces evidence of the past, even the most recent.

In the course of the executive meeting of the Conference, the bureau of the Association was reconstituted: M. Montel, the eminent mathematician, dean of the Faculty of Sciences of Paris, was elected president for the year 1946; the congress over which he will preside will be held at Nice. M. Fage, professor in the Natural History Museum, was elected vice-president.

TWO VELOCITIES OF SOUND IN HELIUM-II

A CONSEQUENCE of the theory put forward in 1941 by the Soviet physicist, Landau, to explain the peculiar flow-properties of liquid helium[1] was the co-existence of two speeds of sound in this medium. Prof. E. N. da C. Andrade, in his recent account[2] of contemporary physical research in the U.S.S.R., stated that Peshkov had succeeded in demonstrating that a 'second' sound did actually occur in helium-II. A paper giving details of the theoretical background and the experimental technique used was delivered earlier in 1945 by E. M. Lifshits and V. P. Peshkov before a gathering of the Physico-Mathematical Section of the Academy of Sciences of the U.S.S.R., and a summary of the work appears in an issue of the Academy's *Herald*, which has recently been received[3].

According to Landau's theory, liquid helium at temperatures below the λ-point, 2·19° K., is a 'mixture' of two types of helium, superfluid and normal, which differ in their rates of flow. On this basis he was able to give an explanation of most of the known flow-properties of helium-II and to indicate a way in which the theory might be tested. An application of the hydrodynamic equations to the study of the propagation of sound in superfluid helium showed that there ought to occur, in addition to the 'primary' sound wave, a wave of another type ('secondary') which would be peculiar to helium-II. The primary wave corresponds with normal sound waves; it is propagated at 240 m. per sec. and the speed is nearly independent of the temperature. The speed of the secondary wave should change rapidly with temperature and be nil at the transition point. According to Lifshits's analysis, the primary wave occurs when the particles of superfluid and normal helium in any given element of volume vibrate so that the liquid moves as a whole; the secondary, when there is relative movement between the particles, governed by the principle that the centre of gravity of each element remains stationary. In the latter case the amplitude of pressure oscillation is small and the effect of temperature is great; the reverse applies to the primary wave.

This picture made it necessary to suppose that all the usual methods of exciting sound waves would produce only the one primary type of sound in liquid helium-II. A special method employing temperature variations instead of pressure variations was required. This was found in the vibrations of a solid surface, the temperature of which could be made to change periodically with time. A thermal oscillator was designed by Peshkov so that, theoretically, only the secondary sound wave should be radiated.

A glass tube, 2 cm. in diameter and 25 cm. long, was placed in liquid helium. The bottom of the tube was closed with a flat glass disk and the other end was left open. Through this end was pushed a flat cylindrical piston with a heater of very thin constantan wire wound on the end of it. There was a small opening in the middle of the piston through which a small thin-walled steel tube could move. At the end of this tube was fixed a small ivory bobbin on which a resistance thermometer of extremely thin phosphor-bronze wire was wound. The electrical resistance of phosphor-bronze changes rapidly with temperature at the temperatures of liquid helium; hence, if the temperature of the helium is made to change periodically and the wire of the thermometer is sufficiently thin to reflect the temperature changes in the helium, then the resistance of the thermometer must also change periodically. When a continuous current is passed through the thermometer, the voltage drop will be proportional to the resistance and it will follow the change of temperature of the helium. It was found, however, that the voltage variations were very small and that they had to be amplified a million times before they could be examined on a cathode ray oscillograph.

On the passage of an alternating current through the heater on the end of the piston, thermal waves of double the frequency were produced. These waves were taken up by the helium, passed to the bottom of the tube, were reflected back to the piston, were reflected again and so on. If the distance between the piston and the bottom of the tube was not equal to a whole number of half-waves, then the phases of the various waves were different and no temperature oscillation was observed at all. If a whole number of half-waves could be packed into this distance, then resonance occurred, standing waves were produced, and a periodic temperature change was indicated on the cathode ray oscillograph.

By changing the position of the thermometer in the tube, it was found possible to measure the length of the waves and, consequently, with a known frequency, to determine the speed of propagation of the thermal vibration. It was thus discovered that the speed increases from 19·5 mm. per sec. at 1·35° K. to 20·4 m. per sec. at 1·65° K. and then rapidly falls, becoming nil at the λ-point (2·19° K.). At these temperatures normal sound travels at about 250 m. per sec. It is stated that within the frequency-range of 100–10,000 cycles per second, a 'dispersion' of speed was not observed.

The experimentally determined values for the speed of the 'second' sound do not agree exactly with those predicted by Lifshits; but it is considered probable that the experimental data upon which the calculations were made were inaccurate. In any event, the results of the work provide a remarkable confirmation of Landau's theory. G. STANLEY SMITH.

[1] See Smith, G. S., *Nature*, **155**, 598 (1945).
[2] Andrade, E. N. da C., *Nature*, **156**, 223 (1945).
[3] *Vestnik Akademii Nauk*, No. 4, 117 (1945).

SOCIAL SURVEY OF KITCHENER–WATERLOO, ONTARIO

IN the early part of 1944 the Canadian Chamber of Commerce sponsored a community fact-finding survey in the twin towns of Kitchener–Waterloo, Ontario. Its purpose was "to find out just what changes had resulted from four and a half years of war, to discover what were the expectations of municipal authorities and business men as to their own post-war needs and opportunities, and to search out and assemble the plans of individuals for themselves and their families". Public interest was enlisted, and the survey met with overwhelming public support. The British Government's Social Survey has a similar experience of public sympathy with surveys, although that organisation has not had the benefit of widespread explanation of its purposes and methods.

In most countries, hitherto, economic intelligence has been for the main part based on national and

industrial production and trading totals. However, parallel with the development of national statistics for purposes of war control, there has been the increasing use of the social survey technique and sampling to provide administrators with the social data necessary for efficient handling of the home front.

The recent Government White Paper on Full Employment indicated that "everything possible must be done to limit dangerous swings in expenditure on private investment". It was further pointed out that "demand may outrun supply and create inflationary rise in prices . . . and . . . civilian production when it is resumed may concentrate on the wrong things from the point of view of national needs. Government action will be directed to forestall, so far as is possible, each of these dangers." It is clear, then, that a method which provides reasonably accurate information about the possible flow of consumers' expenditure could be of great assistance to those responsible for the kind of administrative measures outlined in the White Paper.

In consumer surveys of this sort, based on questionnaires, the technical points which need most careful attention are the selection of the samples, the construction of the questionnaire and the skill of the investigators in securing the co-operation of the informants.

Different methods of selecting the sample in the Kitchener–Waterloo survey were used for the city, village and farm households, and from the varying success achieved it would appear that the level of organization reached in the collection of these samples varied also. Thus 20 per cent of all farms in the area had schedules sent to them by post, and the report says "this was in order to ensure that there would be sufficient usable returns received from which to select the three farms per school section required". It is doubtful whether this kind of *post facto* weighting could overcome the bias due to the fact that farmers represented in the final sample would be drawn only from those completing and returning the schedules. On the other hand, the city households were personally canvassed by volunteer workers who, however, were selected as "capable, responsible people able to understand and explain the purpose of the survey and the individual questions to the householder". There was careful instruction of these canvassers before the work began by experienced investigators, and emphasis was laid on the approach, manner and conduct of an interview. The sample was carefully watched and controlled at all stages.

It appears from the report that the authors hope that "the collection of similar information regarding many samples will increase cumulatively the trustworthiness of the conclusions to be drawn from them, for such conclusions will be derived from a steadily growing mass of data, covering an increasing proportion of the Dominion". Such a process may lead to misleading results. The Kitchener–Waterloo area was chosen for this initial study "not primarily because of its business characteristics but because it was believed that both Boards of Trade would respond favourably to such an invitation . . . make the necessary preparations and complete the task". An accumulation of data from districts which are chosen in this way, or which decide for their own reasons to carry out surveys, may be of interest in itself but will be unlikely to provide data representative of the whole country.

The information sought from these different sections of the community varied in the detail required. Householders were asked to estimate their purchases of items on a printed list of household goods in the first year after the War. The farmers were asked to state the size of livestocks and different crop acreages for 1939 and 1944 and to estimate relevant figures for the first post-war year. In addition to this, farmers were asked to estimate their post-war expenditure on farm buildings and equipment. On the other hand, the business men were asked only to estimate the post-war expenditure on buildings and equipment, the staff to be employed and the estimated pay-roll for the first post-war year.

It seems important to question the basis for these business estimates. Past experience indicates that estimates by business people of the future levels of business activity may err considerably, and planned expenditures on capital equipment are likely to be thrown overboard when they conflict with market conditions. Some kind of check on the basis of the business expenditure estimate would therefore seem desirable. On the household schedules rather more care was taken over this point. The question put to informants "provides a typical list of things which people normally buy, but have done without during the war, and asks which they plan to buy after the war. Only those articles definitely planned for should be stated, not all those things which it would be nice to have." The value of this household expenditures information is greatly enhanced by questions asking how each item in the projection expenditure is to be financed, whether from current income, cash or other savings, instalment credit or borrowing. From this it is possible to judge to some extent what element of doubt there is in the projected estimates, for clearly much greater weight can be put upon expenditure estimates which are to be financed from current income at the time of the projected expenditure.

What is the picture which emerges from the survey? In the area studied, the information gathered shows that the labour force rose by about 34 per cent between 1939 and 1943, although no fewer than one quarter of that 1939 force had enlisted. This shows quite simply the dimensions of the full-employment problem in the area. Secondly, on the basis of estimates of post-war sales, and taking into account people returning from the Services, there is a small prospective *excess* of jobs over available labour.

An interesting comment on this later finding is made in the report: "Over all, the manufacturing industries expect a decline of about 1½% on sales and in the number of employees, but they look for an aggregate reduction in factory payrolls of slightly more than 20%". On the other hand: "The somewhat sketchy statistics of present and anticipated household incomes suggest that citizens themselves expect their post-war incomes to be within 1% or 2% of their present incomes".

This is a most important discrepancy to have unveiled. Clearly if pay-rolls are to be what the business houses expect, then post-war consumers purchases will need to be curtailed, and this means that producers' expected sales will not be made. If the Kitchener–Waterloo survey had shown nothing else, this one finding would in itself have pointed to the most critical stage of any post-war employment policy.

Another interesting finding is that consumers plan to spend almost ten times as much on housing as the Kitchener–Waterloo building firms estimate as the total of their post-war business. Nearly half the total expenditure envisaged is to be on buildings and con-

struction. The difference between consumers estimates and the estimates of business men in this matter arouses a certain amount of scepticism about the estimates of business men on which other conclusions in the report are based. One wonders, for example, how consumers estimates of post-war purchases of domestic appliances, motor-cars or furniture would have compared with the business estimates of sales for these commodities had the business schedules asked for sufficient detail of this sort.

The Kitchener–Waterloo survey is based on the assumption that the end of the War will see a return to the operation of consumers demand in a completely uncontrolled economy. So far as Great Britain is concerned, at any rate, it is doubtful if such conditions will prevail during the immediate post-war years. It has been said that "the guiding principle with regard to the production and distribution of consumption goods, will be to secure, so far as possible, that labour and capacity no longer needed for munition production shall be used for producing civilian goods of high priority—until the primary needs are met, resources which could be applied to meet them should not be diverted to the production of luxuries for home consumption".

This will need detailed information about stocks and needs. Much war-time administrative action has been based on such detailed information of basic needs. Information collected on a national scale would complement the regular censuses of production and national income and expenditure accounts which are promised, and would, in a short time, provide a sufficient body of data on buying habits to act as a complete check on the consumers' estimates.

There will be inevitably many successors to this survey. It is a useful job well done, and future workers in this field will certainly benefit from careful study of the methods used and the results.

(The survey has not so far been put on sale to the public, but the Canadian Chamber of Commerce has made some copies available to interested bodies.)

L. Moss.

SCIENCE IN CANADA AND SOUTH AFRICA

THE third of a series of discussions on the organisation of scientific research in the British Commonwealth, arranged by the Society for Visiting Scientists, was held at the Society's House at 5 Old Burlington Street, London, on January 9, with Dr. C. S. Hanes, director of the Food Investigation Department, Department of Scientific and Industrial Research, in the chair. The speakers were: Dr. W. E. van Heyningen, assistant director of the Wellcome Physiological Research Laboratory; Major E. Boden, Council for Scientific and Industrial Research, Canada; Dr. R. Y. Stanier; Dr. J. G. Malloch, chief scientific liaison officer for Canada; Dr. W. Cullen; Colonel J. H. de Boer, deputy chief of staff, Netherlands Military Administration; Colonel Marquad, head of Army Education Services in South Africa; and Colonel O. M. Solandt, director of Scientific Defence, Canada.

Canada, being the oldest Dominion, also enjoys the most elaborate research organisation. As its primary and oldest industry is agriculture, it was in that field that research was first applied. Dr. William Sanders and Sir Charles Sanders were jointly responsible for the discovery of a new variety of wheat which revolutionized agriculture in North America. This encouraged the Department of Agriculture to establish a vast research organisation with experimental stations all over the country, and special laboratories covering every branch of agricultural science. One of its latest successes has been the reduction of loss from wheat rust. The Department of Mines and Resources deals with the exploitation of natural resources, including sylviculture, forest products, timber utilization as well as minerals. There is a strong Fisheries Research Board, and a Grain Research Laboratory under the Department of Trade and Commerce.

The National Research Council was not established until 1915. Since then, it has achieved, through a system of associated committees, a large measure of co-ordination between different institutions in the country, which has been very valuable, among other things, in mobilizing Canada's scientific resources for war purposes.

However, Canada has a serious problem in the loss of so many of its scientific men, mainly to the United States. The question of the isolation of scientific workers, which has been stressed in all the former discussions on other regions of the Commonwealth, is also a problem in Canada, particularly in the west, and here their southward drift is a natural but undesirable result. The remedy is to improve the conditions of scientific research in Canada and to enlarge university staffs, thereby not only reducing the individual teaching load, but also opening up new fields of teaching and research such as genetics, microbiology, biochemistry, oceanography, etc. Industrial research has so far been relatively neglected in Canada, since all the larger companies are subsidiaries of American firms, and research work is done in the United States for them; but it should now be actively developed.

The problems of Canada are rather different from those of the other Dominions, since it will clearly be necessary to integrate and co-ordinate its scientific activities with those of the United States to at least as great an extent as with those of the rest of the Commonwealth.

South Africa was first colonized by Dutch farmers when the Dutch East India Company established stations to provide fresh food and supplies for the crews of its ships. They were joined by French Huguenots, and after the British took over in 1806, by British immigrants, following the Industrial Revolution. Early British rule was unenlightened and caused a split in the population which endures to this day. The discovery of diamonds and gold, which created a boom, set mining as the second main facet of South African life, the first being agriculture. The population to-day is ten million people. The Africans outnumber the whites by four to one, and the 20 per cent of poor whites among the Europeans constitute a special problem. Only about one fifth of the total population have attained what may be regarded as a minimum standard of life. To raise this level, the production of the country must be raised.

Agriculture, though fairly self-supporting and occupying two thirds of the population, only utilizes 6 per cent of the land surface. This is due to several reasons: bad farming habits, dry soil, excessive evaporation, irregular rains. Moreover, Schwartz has produced evidence in favour of the view that the dryness of South Africa has progressively increased owing to the diversion of great rivers from large

inland lakes in Bechuanaland to the Indian Ocean and the Atlantic. His remedy was to divert these rivers back into their original courses. This scheme is now once more being considered, together with large-scale irrigating proposals.

Over most of the country, the poverty of the soil makes it more suitable for stock-farming, which, however, brings its own problems of animal disease, parasitic and nutritional. The Veterinary Research Institute at Onderstepoort, probably the largest in the world, is tackling these problems. The country is also well provided with agricultural colleges, experimental farms and research stations. The Low Temperature Station in Cape Town has produced improved methods for preserving and transporting food. Mention should be made of the sugar-cane production of the west sub-tropical belt, with its special experimental and research station. Afforestation is being carried out on a large scale by the Division of Forestry to make up for lack of natural forests; the Division of Soil and Veld Conservation is coping with problems of erosion and with the education of farmers; the locust has its special research department. Yet much more research is needed before the land can be properly utilized.

The need for industrialization is obvious and urgent, as the gold industry, based as it is on the moribund gold-standard, has a precarious future, and the smaller diamond industry shows signs of reduction in importance. This need can only be solved by the application of science on a much larger scale than at present. However, the supply of trained scientific workers, especially in the physico-chemical sciences, from the four universities of the Union will have to be materially increased to meet this need.

STUDIES OF ATMOSPHERIC POLLEN

MR. H. A. HYDE, keeper of the Department of Botany in the National Museum of Wales, and Dr. D. A. Williams, of Llandough Hospital, Cardiff, have previously published (*New Phytol.*, **43**, 49; 1944) an important census of atmospheric pollens at Cardiff compiled during 1942 as a first publication in their studies of aerial pollen, which they have since termed 'palynology' (see *Nature*, **155**, 264; 1945). In this they showed that, in the aggregate, grass pollens formed 75 per cent of the total pollen deposit caught (by a gravity slide method).

Their observations upon grass pollen have been greatly extended since, and the second part of their "Studies in Atmospheric Pollen" (*New Phytol.*, **44**, 83; 1945) is devoted to the diurnal variation in the incidence of grass pollen which they have demonstrated. Preliminary experiments in 1943 and more detailed experiments in 1944 with the exposure, for two-hourly periods throughout the day and night, of gravity and 'impact' slides (the latter mounted vertically and kept at right-angles to the direction of the wind) are recorded together with relevant meteorological data. The results from a site in good grassland and another upon the hospital roof near by were in good agreement and enable the authors to draw definite conclusions.

The 'impact' catch was always the more sensitive index of the amount of atmospheric pollen, which was found to follow closely the times of mass anthesis of the local grasses when pollen is liberated in large quantities. On fine, sunny days the principal grasses (*Festuca rubra* and *Holcus lanatus*) flowered slightly in the morning and profusely in the late afternoon, and this was reflected, immediately, in the relative heights of the pollen maxima which were obtained at these times. On the days when *Arrhenatherum elatius*, with its early morning anthesis, flowered there was a greater pollen maximum in the morning. Consequently, the time of maximum pollen concentration is likely to depend upon the predominant grass in the neighbourhood. On dull days anthesis was suppressed largely and local pollen concentrations remained low. When such a day was followed by one of bright sunshine exceptionally high concentrations were recorded. Rain may clear the air of pollen.

The authors quote another experiment at St. Mary's Hospital, Paddington, London, and from all their results disagree with Rempe's conclusion that, during day-time, large quantities of pollen are carried to a considerable altitude, and sediment, often at great distances, during the night. They ascribe this disagreement to the different conditions obtaining with tree pollen which formed most of Rempe's samples.

LIFE-HISTORY OF *PANDALUS BOREALIS*

THIS prawn is of commercial importance both in Atlantic and Pacific waters. In Norway, researches have been carried on in connexion with its life-history, the latest published results being those of Birger Rasmussen[1].

Samples were collected continuously from Vigrafjord on the west coast of Norway, during September 1943–May 1944, and the material treated in the same way as in the author's former paper, on prawns from Spitsbergen[2].

The pelagic larval stages are not dealt with, the smallest prawns caught on the bottom measuring 43·5 mm. in length at the end of September when they are about five months old, and at 1½ years they have reached a length of 88 mm. Most of these small prawns of 1½ years are sexually mature males.

The most interesting facts about these prawns are the sex changes. The age-group of 1½ years old chiefly consists of males spawning for the first time; but a few of these, and the largest individuals, are found in a transitional stage between male and female, maturing later as ovigerous females.

The group of mature males of 1½ years old at the end of December splits into two, one retaining the male characters, the other changing to a transitional stage later to ripen into females. Here again the larger prawns in the age group become females and the rate of growth after the division is greater in the females than in the remaining males.

The individuals of 2½ years old which have spawned twice as males during the following winter go over to the transitional stage and gradually change into females which spawn for the first time as females when 3½ years old.

The population of ovigerous prawns in the Vigrafjord is mainly composed of 2½ year-old first-time spawners, those of 1½ and 3½ years being scarcer. Prawns of 1½ years old may constitute 92 per cent of the catch and as they become older their number decreases rapidly.

[1] Trekk fra dypvannsrekens biologi i norske kystfarvann. I. Vigrafjorden, Møre. Fiskeridirektoratets Skrifter. Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations. Vol. 8, No. 2. Published by the Director of Fisheries. Preliminary Report with English Summary and Figure-texts. (Bergen, 1945.)

[2] Fiskeridirektoratets Skrifter, Serie Havundersøkelser. Vol. 7, No. 4. (1942.)

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, February 16

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne 1), at 2.30 p.m.—Mr. R. S. McLaren: "Notes on Thin Seam Mining in the United States of America".

Monday, February 18

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—"Synthetic Fibres" (Cantor Lectures, 1).

CHEMICAL SOCIETY (in the Chemistry Department, University College, Dundee), at 5 p.m.—Prof. C. W. Davies: "Electrolytic Dissociation in Salt Solution".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—Wing-Comdr. Maclure: "Technical Aspects of the *Aries* Flight".

INSTITUTE OF FUEL (joint meeting with the INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS, at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6 p.m.—Mr. Donald V. H. Smith: "Individual and District Heating Systems—Cost, Technique and Planning".

INSTITUTION OF ELECTRICAL ENGINEERS, LONDON STUDENTS' SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Dr. A. J. King: "The Measurement and Reduction of Noise" (Students' Lecture).

Tuesday, February 19

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Prof. Pable Martinez del Rio: "Recent Developments in Mexican Research".

ROYAL SOCIETY OF ARTS, DOMINIONS AND COLONIES SECTION (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir E. J. Salisbury, F.R.S.: "The Work of Kew in the Interests of the Overseas Empire".

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Dr. A. G. G. Thompson: "Land Utilisation in relation to the Public Health".*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. H. Hartridge, F.R.S.: "Some Recent Advances in the Physiology of Vision".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5.30 p.m.—Miss Amice M. Calverley: "Some Records of Peasant Life in Roumania".

BRITISH RHEOLOGISTS' CLUB (joint meeting with the ROYAL AERONAUTICAL SOCIETY, at 4 Hamilton Place, Piccadilly, London, W.1), at 6 p.m.—Prof. N. F. Mott, F.R.S.: "Griffith Theory of Cracks in Solids and Recent Developments of this Theory, with application to Brittle Fracture in Glass and in Metals".

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Princes' Gate, London, S.W.7), at 6 p.m.—Dr. J. A. Thom: "Latent Image Formation in Thallous Bromide".

Wednesday, February 20

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.30 p.m.—Prof. F. T. Randall: "Radar".

INSTITUTE OF FUEL, YORKSHIRE SECTION (joint meeting with the NATIONAL SMOKE ABATEMENT SOCIETY and other bodies, at the Danum Hotel, Doncaster), at 2.30 p.m.—"Technical Progress in Smoke Abatement" (Papers will be presented by Dr. H. A. Fells (Industrial), Mr. W. A. Wordley (Industrial), and Dr. J. E. Garside (Domestic).)

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS GROUP (at Gas Industry House, 1 Grosvenor Place, London, S.W.1), at 2.30 p.m.—Dr. P. A. Small: "The Diffusion of Plasticisers from Polyvinyl Chloride Compositions".

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, South Kensington, London, S.W.7), at 5 p.m.—Mr. E. G. Dymond: "British Radio-sonde in Theory and Practice".

INSTITUTE OF PHYSICS, ELECTRONICS GROUP (at the Royal Institution, 21 Albemarle Street, London, W.1), at 5.30 p.m.—Discussion on "The Permanence of Components in Electronic Equipment" (to be opened by Dr. W. B. Lewis).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. F. F. Roberts: "New Methods for Locating Cable Faults, particularly on High-Frequency Cables".

ROYAL INSTITUTE OF CHEMISTRY (at the Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1), at 6 p.m.—Dr. H. J. T. Ellingham: "Chemical Affinity Data and their Industrial Applications".

BRITISH INSTITUTION OF RADIO ENGINEERS, LONDON SECTION (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.15 p.m.—Flight-Lieut. C. Bovill: "Aircraft Radio".

SOCIETY OF CHEMICAL INDUSTRY, MICROBIOLOGICAL PANEL OF THE FOOD GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Dr. S. E. Jacobs: "Some Aspects of Disinfection".

THE POLYTECHNIC (in the Fyvie Hall, The Polytechnic, Regent Street, London, W.1), at 6.30 p.m.—Mr. Cecil Hepworth: "The Film To-day", 1: "The Story of the Film".*

Wednesday, February 20—Friday, February 22

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 10.30 a.m. and at 2.15 p.m.—Mr. H. Constant and associated authors: "The Development of the Internal Combustion Turbine".

Thursday, February 21

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. J. M. Burgers: "Turbulence".

CHEMICAL SOCIETY (in the Muspratt Lecture Theatre, The University, Liverpool), at 5 p.m.—Dr. F. E. King: "The Chemical investigation of some New Therapeutic Agents".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Gray, F.R.S.: "Life in the Sea".

CHEMICAL SOCIETY (joint meeting with the UNIVERSITY COLLEGE OF NORTH WALES CHEMICAL SOCIETY, in the Department of Chemistry, University College, Bangor), at 5.30 p.m.—Mr. R. P. Bell, F.R.S.: "The Structure of Boron Hydrides and Similar Compounds".

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (in the Reynolds Hall, College of Technology, Manchester), at 5.30 p.m.—Mr. Gordon Manley: "The Climate of Lancashire".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26 Portland Place, London, W.1), at 8 p.m.—Dr. H. L. Marriott: "Medical Experiences of the War in South-East Asia Command".

Friday, February 22

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Geophysical discussion on "Clouds" (to be opened by Mr. C. J. P. Cave and Prof. D. Brunt, F.R.S.; Mr. D. R. Barber will illustrate the discussion with a cinematograph film).

CHEMICAL SOCIETY (in King's College, Newcastle-upon-Tyne), at 5.30 p.m.—Prof. W. Wardlaw: "Structural Inorganic Chemistry" (Bedson Club Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. G. Garton: "The Characteristics and Errors of Capacitors used for Measurement Purposes".

INSTITUTION OF MECHANICAL ENGINEERS, APPLIED MECHANICS GROUP (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. G. A. Hankins and Mr. W. F. Cope: "Flow of Gases at Sonic and Supersonic Speeds".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. A. Kari: "An Investigation into the Phenomena of Screw Propeller Action".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 6.30 p.m.—Mr. F. J. Tritton: "The Photographic Copying of Documents and Plans".

BRITISH ASSOCIATION OF CHEMISTS, ST. HELENS SECTION (at the Y.M.C.A. Buildings, St. Helens), at 7.30 p.m.—Mr. H. Cole: "Chemistry of Coloured Glasses".

CHEMICAL SOCIETY (joint meeting with the LOCAL SECTIONS of the ROYAL INSTITUTE OF CHEMISTRY and the SOCIETY OF CHEMICAL INDUSTRY, at the North British Station Hotel, Edinburgh), at 7.30 p.m.—Prof. E. L. Hirst, F.R.S.: "Some Problems in Polysaccharide Chemistry".

Saturday, February 23

ASSOCIATION OF SCIENTIFIC WORKERS (joint meeting with the ASSOCIATION of UNIVERSITY TEACHERS and the BRITISH ASSOCIATION OF CHEMISTS, at the Wellcome Research Institution, 183 Euston Road, London, N.W.1), at 3 p.m.—Conference on "The Training of Laboratory Technicians".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN THE DEPARTMENT OF CHEMISTRY—The Principal, Derby Technical College, Normanton Road, Derby (February 23).

LECTURER IN CIVIL ENGINEERING—The Director, Robert Gordon's Technical College, Aberdeen (February 26).

GRADUATE LECTURER IN GEOGRAPHY, and a GRADUATE LECTURER IN MATHEMATICS, in the Coventry Technical College—The Director of Education, The Council House, Coventry (February 27).

ASSISTANT CYTOLOGIST to take part in routine and research investigations on cancer—The Secretary, Royal Cancer Hospital (Free), Fulham Road, London, S.W.3 (March 1).

LECTURER IN MATHEMATICS (qualified to teach to Honours Degree standard), and a LECTURER IN MATHEMATICS AND PHYSICS (able to take either or both to General Degree standard)—The Registrar, Portsmouth Municipal College, Portsmouth (March 2).

PRINCIPAL OF THE HUDDERSFIELD TECHNICAL COLLEGE—The Director of Education, Education Offices, Huddersfield (March 9).

DEMONSTRATOR IN PHYSIOLOGY AND PHARMACOLOGY—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1 (March 15).

PROFESSOR OF PHYSICS, and a PROFESSOR OF CHEMISTRY—The Registrar, The University, Reading (March 25).

METALLURGIST by the Ceylon Government for the Department of Commerce and Industries—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.14681.

LECTURER IN PHYSIOLOGY in the Department of Pharmacy and Biology—The Principal, Birmingham Central Technical College, Suffolk Street, Birmingham 1.